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The German Railways
An Analysis of Economic Adaptation

By JOHN P. CARTER*

PERHAPS more than those of any other western territory, the German railways have had to adapt themselves to postwar conditions which are sharply different from those of the prewar period. The other western countries remain with borders and internal trade patterns not very different from those existing before the war. Transport reconstruction, in the physical sense, meant rebuilding along the prewar pattern, since that had been the most suitable for the traffic. Economic reconstruction, induced by the evergrowing inflation, took the form of general rate increases. In Germany, however, the problems of the immediate wartime physical destruction were compounded by the increasingly complete separation of Germany between east and west, and by an inflation sufficiently drastic so that a currency reform was undertaken.

During and after the invasion and collapse of Germany in 1945, long distance rail services ceased for the most part, although it would appear that locally, within the limits of equipment and supplies, some trains moved. After the fixing of the zones of occupation, the military authorities of each zone established their own railway headquarters. In the summer of 1945 the American headquarters were established at Frankfurt and the British at Bielefeld. In early 1946 the French zone headquarters was set up at Speyer. In the fall of 1946, consequent upon the economic merger of the United States and British zones, the railway administration for the bizone was also consolidated, the functions of the administration being distributed between the two former headquarters. There followed years of increasing independence for the German management, which included, about 1949, the physical removal of the head office to a suburb of Frankfurt, Offenbach am Main. The Germans thus obtained, by virtue of physical separation from the Allied High

* Associate Professor of Business Administration, University of California, Berkeley.

A grant from the Social Science Research Council permitted travel, during sabbatical leave, for the research. Special thanks are due to Ministry advisors Dr. Kreul and Dr. Wattenberg of the Bundesbahn administration in Offenbach, and to Mr. Breecher of the Allied High Commission in Frankfurt, for their assistance.

Commission, a degree of autonomy. About that same time, with the formation of the Federal Republic, the railways of the French zone came nominally under the control of Offenbach, although, as of the summer of 1951, that integration was not yet complete.

Thus, by late 1951, the German railways had returned to substantially autonomous German control, and had reestablished physically nearly all the lines which had existed before the war. Much of the restoration was on a temporary basis: only one span of the main bridge at Cologne was patched, thus carrying two tracks instead of four; the Rhine bridges at Remagen and Mainz were not restored; some new rolling stock had been built; and some passenger equipment had been refurbished and modernized. Nevertheless, in terms of their ability to produce transportation, the west German railways were back in business in 1951. In some markets, such as passenger, additional traffic was actively sought while, in freight, many of the old competitive problems had re-emerged.

It seems interesting to inquire, now, how those railways have adapted themselves to present conditions. West Germany contains more than half the area and two-thirds the population of pre-expansion Germany, that is, the 1936 territory. By 1949 the west German railways were carrying two-thirds as many ton-miles as did the German railways in 1936, and more than half as many as carried in 1938 after the Germans had begun their program of territorial aggrandizement. Comparisons of traffic, prewar and postwar, within the territorial limits of present west Germany, cannot be made since statistics were not kept, of course, for that particular area in the prewar period. It is estimated, however, that west German railways were carrying in 1949 about the same quantity of traffic as was carried in that same area in 1936.[1] 1950 saw no change.[2]

In west Germany, now the Federal Republic, the railways are called the German Federal Railway (Deutsche Bundesbahn). In west Germany the word "state" (Reich) has fallen into disfavor, although in the Russian zone the railways are still called the German State Railway (Deutsche Reichsbahn).

Prewar statistics are not always available, much material having remained in Berlin; even though the west zone railways are now staffed with many people formerly at Berlin. Postwar statistics are available, however, in considerable detail for the United States-British zone, and in increasing detail for the French zone and the Federal Republic as a whole.

Excellent data are available on the total volume of traffic over the main routes of the Bundesbahn in the form of a schematic map.[3] Distinguished for both freight and passenger trains, the chart shows number of trains, number of axles,[4] gross tons and locomotive weights. For freight trains net tons are also shown. The statistics are based on a one-day sample, the day being a Thursday in mid-March. No data are available, however, for individual commodities by individual routes. Traffic in individual commodities is reported in totals for the entire bizone in the annual statistical report.[5]

[1] United Nations, Economic Commission for Europe, Transport Division, *Annual Bulletin of Transport Statistics, 1949* (Geneva: 1950), p. 14.

[2] *Ibid.*, p. 54.

[3] Deutsche Bundesbahn, Eisenbahndirektion Wuppertal, *Streckenbelastungskarte der Hauptstrecke von West—und Süddeutschland*, Wuppertal. (Annual in recent years.)

[4] Axle count is a frequently-used statistic in Europe, often for inter-line settlement purposes. The United States, with its relatively uniform equipment, can use the car as the accounting unit; but European rolling stock, although most freight cars have but two axles, comes in a wide variety of sizes, capacities, and axle counts.

[5] *Op. cit.*

I

The most obvious effect of the division of Germany has been, of course, the change in direction of the traffic movements. The basic prewar pattern had been an east-west flow, a major component of which was the carriage of coal to Berlin from the Ruhr on the west and Silesia on the east.

Coal continues to be the major item of Bundesbahn traffic. In 1949 it accounted for 40% of the tonnage carried and a third of the total freight revenues.[6] That same proportion prevailed in 1936 and 1950.[7] Bundesbahn officials, nevertheless, consider a third of the tonnage and a quarter of the revenues to be a more "normal" relation for the coal traffic. Although the coal flow has been diverted, like all west German traffic, from an east-west to a north-south movement, and has thus become increasingly vulnerable to the competition of the Rhine barges, that competition remains largely potential. The river traffic of west Germany in 1949 had recovered to less than 60% of its prewar level.[8] 1950, however, saw an increase of nearly 25%, so that that year's traffic reached some 72% of the prewar level.[9] This failure of the waterways to recover seems to be due almost entirely to a shortage of physical equipment. In 1950 the German inland dry cargo fleet amounted to 2,852,000 tons (of which 85% were dumb barges) compared with 4,364,000 tons in 1939.[10] The fleet itself is thus only two-thirds its prewar size. Failure to fully reconstruct the fleet is ascribed to a shortage of capital,[11] in spite of which the fleet had grown by some 10% from 1949 to 1950.[12]

The most heavily trafficked routes of Bundesbahn are those extending northeast and southeast from the Ruhr; and, on those routes in particular, coal must be the dominant item of traffic. The traffic to the southeast is much the heaviest; on the sample day in 1951 freight trains handled 100,000 net tons and 172,000 gross tons, southeast from the Ruhr.[13] Coal must have been the major commodity component in that tonnage figure. This represents a heavy movement even by American standards. The average daily traffic eastbound across Nevada on the Southern Pacific during 1950 was 48,000 gross tons.[14] That represents the most densely trafficked portion of the entire Southern Pacific. Certain eastern coal roads may have a traffic density more nearly approaching that of the German lines.

Seventy-five percent of that southeastward flow was by the lines along the Rhine, the remainder on the more easterly route from Hagen through Wetzlar. About 60,000 net tons were handled northeastward towards Hannover and Bremen. Compared to 1949, freight traffic over the above indicated routes radiating from the Ruhr has increased by some 30%, measured by net tons, although that increase has not been uniform on all those routes. The Rhine lines, the largest, have increased by about 30%; the eastern line through Wetzlar, by some 12%; while the route toward the ports has grown by 40%; and toward Hannover (and Berlin) by only 20%.

[6] Deutsche Bundesbahn, *Statische Angaben uber die Deutsche Bundesbahn*, Offenbach a/M., 1949, pp. 234, 253 and 257. These items refer to the bizone only. No comparable data are available for the French zone.

[7] Statische Bundesamt, *Wirtschaft und Statistik*, December 1951, p. 476.

[8] United Nations, Economic Commission for Europe, *Annual Bulletin of Transport Statistics* (Geneva: 1950), Corrigenda to 1949 issue, p. 1.

[9] United Nations, Economic Commission for Europe, *Annual Bulletin of Transport Statistics* (Geneva: 1950), p. 70.

[10] Allied High Commission, *Basic German Inland Waterway Report*, Frankfurt: April 30, 1951. (Mimeographed) p. 9.

[11] *Ibid.*, pp. 3-4.

[12] *Ibid.*, p. 9.

[13] *Streckenbelastungskarte, op. cit.*

[14] Southern Pacific Transportation System, *Density and Trend of Freight Traffic on Main Lines*, Executive Department Statement No. 50, San Francisco, April 4, 1951.

There is probably little coal traffic moving toward Berlin, although on the sample day in 1951 some 8000 net tons, total traffic of all sorts, moved into Helmstedt, the zonal border point on the principal line toward Berlin. The coal traffic would appear to move southeastward not much beyond Stuttgart and Würzburg. To the northeast, traffic seems to be distributed generally into the industrial cities of Hannover, Braunschweig, and the Hanseatic port cities.

In general it would appear that coal traffic is moving shorter distances than before the war, although prewar data are lacking. In part, the reduction in the length of haul follows from the smaller size of west Germany compared with prewar Germany. But it also is true that the elimination of the Silesian coalfields from the German economy leaves west Germany dependent largely on the Ruhr and the Saar coalfields, especially the former. Distances from the Ruhr to the apparent margin of important consumption points indicated are relatively short:[15]

Oberhausen—Stuttgart	467 km.
Oberhausen—Würzburg	429
Oberhausen—Hannover	263
Oberhausen—Braunschweig	324
Oberhausen—Berlin	559
Wanne-Eickel—Bremen	240
Wanne-Eickel—Hamburg	362

The Silesian coal faced a somewhat longer haul:[16]

Beuthen—Berlin	520 km.
Beuthen—Hamburg	708

The German coal tariff has been designed, since the first war, to make allowances for the greater distances from the Silesian fields to market and, despite the disappearance of Silesian competition in the market structure, the tariff still follows that pattern.

It is perhaps worth noting that the German coal tariff[17] is a simple, though not linear, distance tariff. That is, rates are quoted by mileage only, and not to or from named stations. The coal tariff has, moreover, a quite general application to all forms of peat and coal in all grades, including dust, briquettes, and coke.

Before the beginning of this century, the coal tariff had departed from a linear distance structure, developing a point of flexion at 350 km., and at a reduced, but again linear, rate beyond that distance.[18] In 1924 the coal tariff was again reduced, for distances in excess of 350 km., to provide a taper, becoming almost horizontal, for distances between 400 and 700 km., so that, for distances between 350 and 700 km., a doubling of the distance, the rate increased by no more than 20%. Such distances were, of course, the really competitive distances for the Ruhr and Silesia, nor was a significant portion of Germany more than 700 km. from one area or the other. This rate structure had the effect of establishing a plateau on coal rates, a rate which was essentially uniform to all parts of the country more than 350 km. from the mines. For distances in excess of 700 km. from the origin there was another point of flexion, and the rate increased again as a linear function of distance, but it is probable that the rails handled little traffic over hauls of such lengths. Coal could always be handled by Rhine barge to ports such as Mann-

[15] Distances calculated from *Amtliches Kursbuch* (Deutsche Bundesbahn, Generalbetriebsleitung West, Bielefeld) Summer 1951.

[16] Distances calculated from *Deutsches Kursbuch* (Deutsche Reichsbahn, Oberbetriebsleitung Ost, Berlin) Winter 1938).

[17] Deutscher Eisenbahn-Guter-und Tiertarif, Teil II, Heft C, *Ausnahmetarif 6 B 1* (Eisenbahndirektion Essen) January 1, 1951.

[18] R. Cottier and L. M. Homberger, *Report on the Deutsche Bundesbahn*, Offenbach am Main, April 17, 1950 (English translation mimeographed) Table 8, p. 68. This report was sponsored by the Bundesbahn under its own initiative.

heim, so that the rail haul, even to the southeast corner of Bavaria, could be held to within 700 km.

Subsequent modifications, in 1931 and in 1950, have smoothed the 1924 curve by substantially reducing the rates for the shorter hauls, the maximum reduction being at the previous point of flexion, 350 km. The rate of progression with distance continues to be minimized between 450 and 750 km. It is interesting to note that even the 1950 tariff preserves the structure introduced by the equalization of rates from the Ruhr and Silesia, even though Silesia is not even in the Russian zone, but has been incorporated into Poland. (This may well be a technique by which the west Germans demonstrate their refusal to recognize the Oder-Neisse line.)

With the coal business constituting far and away the most significant item of German freight traffic, it is not surprising that its handling has come in for attention in the report of an American firm of management engineers.[19] The biggest assembly yard is located at Gremberg, across the Rhine from Cologne. There the coal trains are assembled for movement up the right bank of the Rhine. (As indicated earlier, about two-thirds of the southbound freight traffic up the Rhine is handled along the east shore.) Coverdale and Colpitts' particular criticism of Bundesbahn operating practice dealt with what they considered wasteful operating techniques. They pointed out that the railway adhered closely to planned schedules,[20] and that trains leaving Gremberg were rarely loaded to the limit of 60 cars, imposed by the lengths of sidings, or the 1600-ton limit of the locomotives in conventional use.[21] There is a general agreement that the locomotive fleet is overbalanced with heavy freight engines.[22] Coverdale and Colpitts suggest that these heavy locomotives, which constitute the most modern stock, having been built during the war, be used more nearly to their rated capacity,[23] and that sidings be lengthened so that locomotives can be loaded to their capacity, thus reducing train-miles, an important cost unit, at least in American railroading. Bundesbahn officials, however, point out that sidings are located in stations, and that they can be lengthened only at the cost of condemning property occupied by existing buildings and demolishing those buildings. Since the demolition of buildings in Germany was carried out at a phenomenal rate during the war, it is difficult for the Germans to develop much enthusiasm for further destruction of an already scarce asset.

Furthermore, the railway officials make the point that the Bundesbahn possesses plenty of locomotives,[24] and labor, but that there is a shortage of cars. The Bundesbahn is in a somewhat peculiar position with its labor force. It has been under the legal obligation to absorb returning soldiers and prisoners who had previously been railroad men, and also to absorb those refugees from the Russian zone who had been Reichsbahn employees in that zone. After December 1949 the Federal Ministry of Transport forbade dismissals from the Bundesbahn,[25] and thus the wage bill became something like a fixed charge to the Bundesbahn. This policy left the Bundes-

[19] Coverdale and Colpitts, *Report on the Deutsche Bundesbahn* (New York:) July 12, 1950. (Offset). This report was sponsored by the Bundesbahn at the instigation of the Allied High Commission.

[20] *Op. cit.*, pp. 220-221.

[21] *Op. cit.*, p. 143.

[22] Coverdale and Colpitts report, p. 108; Cottier and Homberger report, p. 141.

[23] Coverdale and Colpitts also consider the rated capacity to be too conservative, p. 111.

[24] Coverdale and Colpitts (p. 113) and Cottier and Homberger (p. 141) reports agree on the locomotive surplus.

[25] Cottier and Homberger, *op. cit.*, p. 117.

bahn with excess employment which Coverdale and Colpitts estimated at 20%.[26] Their recommendation was simply discharge, although they recognized that alternative employment was unavailable and that these men would become unemployed. While such action is not politically impossible in an occupied country, it is unlikely that the net productivity of these railway workers is zero; as it would have been in unemployment. There are many things extra labor can do. Given, as in this case, an ample locomotive supply, extra train-miles can be run for little or no extra wage bill. Even without materials and equipment, an adequate labor supply makes many maintenance operations possible.

Statistical evidence of a car shortage is difficult to find. While the car supply has shrunk in numbers by about one-third of those previously maintained in the bizone, the locomotive supply has diminished by less than a quarter.[27] The Coverdale and Colpitts report makes no mention of a car shortage, merely indicating that the car records were a war casualty and that a new inventory had not been completed.[28] Figures of the International Railway Union, however, indicate that the car supply has fallen less than the locomotive supply,[29] even though car figures are for Germany and Austria, while locomotive figures are for Germany only. But unserviceable equipment is not distinguished, though the proportion is known to be high. While comparable prewar figures are not available, the Bundesbahn itself indicates that only 258,000 of the 330,000 freight cars in the three zones of west Germany were serviceable in 1949.[30] Bundesbahn figures indicate a locomotive stock of 15,679 in the three western zones, of which 8,069 are in use, 977 in good order reserve, 3,248 damaged, and 3,385 held back from repairs.[31] The latter are presumably permanently withdrawn from service.

United Nations data indicate that western Germany had 337,000 freight cars in 1949, of which 264,000 were in running condition. In 1950 total stock declined to 302,000 due to scrappage; but cars in running order rose to 267,000.[32] West German total steam locomotive stock in 1950 was 14,839, of which 41% were awaiting repair.[33] Thus about 8,750 were usable in 1950.

While these various sources are not in precise agreement, they are by no means clearly inconsistent with each other. A reasonable judgment might well be that the west German car supply has shrunk by one-third, the average capacity by 5%,[34] and the locomotive stock has declined by perhaps 10% in number of units and conceivably grown in total power, considering the heavy freight locomotives built during the war.[35] These amounted to:

[26] Coverdale and Colpitts report, p. 204.

[27] Cottier and Homberger report, pp. 140-145. Serviceable car supply in 1936 in the bizone was 320,000; in 1949, 232,000. Locomotive stock was about 10,300 in 1938, and 10,800 in 1949, of which 7,900 were serviceable.

[28] Coverdale and Colpitts resort, p. 124.

[29] Union Internationale des Chemins de Fer, *Statistique Internationale des Chemins de Fer* (Paris). Annual.

	1938	1949
Freight cars (railway and private)	[c] 667,000[a]	330,000[b]
Steam locomotives[d]	22,913[c]	10,880[b]

[a] Germany and Austria. [b] Bizone. [c] Germany only. [d] Table 1-2, col. 19. [e] Table 1-3, total of cols. 42 and 46 (1938); table 1-32, total of col. 20 and 25 (1949).

[30] Deutsche Bundesbahn, *Anhang zu Statische Angaben über die Deutsche Bundesbahn* (Offenbach am Main: 1949), p. 30.

[31] *Ibid.*, p. 27.

[32] United Nations, Economic Commission for Europe, *Annual Bulletin of Transport Statistics, 1950* (Geneva: 1951), p. 62.

[33] *Ibid.*, p. 58.

[34] Union Internationale des Chemins de Fer, *op. cit.*, table 1-3, col. 44, (1938); table 1-32, col. 23, (1949).

[35] Cottier and Homberger report, pps. 138-139.

1939	704
1940	988
1941	1394
1942	2159
1943	4535
1944	3061
1945	103
War Total	12,944

Wartime locomotive construction for the account of greater Germany thus exceeded the present total stock in west Germany.

Whatever conclusions one may wish to draw from the statistical evidence, the fact that the Bundesbahn management was able to keep about 1,000 locomotives, or some 12% of its total stock, in good order reserve while those in use were operated at less than capacity, would not negate the conclusion of a shortage in the supply of rolling stock; while the loss of one-third of the prewar inland water transport capacity would support that conclusion. In these conditions, the Bundesbahn management, by promoting rapid delivery and thus short turnaround of its possibly scarce rolling stock, through the lavish use of its clearly abundant motive power and labor appears to show itself as a better economist than the American engineering firm.

II

In the last decade all countries have had to deal with the problem of the upward adjustment of transport rates as a part of the world-wide inflationary trends. In the United States, for example, four cumulative increases have been granted since 1945, but those increases, beyond a degree of geographical variability, have not fallen identically on all commodities. The end result has been to produce the greatest increases on the rates for manufacturers and miscellaneous, and the least increases on the rates for raw materials, particularly agricultural and mineral.[36]

The Germans have faced a much more complicated problem, since they had a violent real inflation in the form of extreme shortages of goods for sale at legal prices coupled with rather vigorous price control at the factor level, particularly wage control. The inflation was followed by deflation when the Deutschemark was substituted for the Reichsmark. The currency reform was intended to put German prices back on more or less the prewar level. Current incomes were continued in D-marks at the same level that they had been in Reichsmarks, but debts were converted at a 10 to 1 ratio, and only about one-third of the money supply in Reichsmarks was carried forward into Deutschemarks. The formula was somewhat complex; very small currency holdings being converted on a 1-to-1 ratio, and the bulk of larger holdings being cancelled.[37]

It is worth noting that there has been little economic interference with German management by the occupation authorities. In the rate field the occupation authorities abolished certain international rates which they considered to discriminate against neighboring countries. The occupiers took no action on domestic rates. Nor did the Germans make changes in freight rates during the postwar Reichsmark period. In 1948, a few months after the currency reform, freight rates were raised by a uniform 40%; the 40% rate increase, however, raised average unit revenues by only 25%.[38]

Failure of revenues to rise was probably due to the diversion of traffic in the

[36] Interstate Commerce Commission, *Monthly Comment on Transportation Statistics* (Washington: October 12, 1951), p. 8.

[37] The German currency reform is neatly summarized by H. S. Ellis, *Economics of Freedom* (New York: Harper, 1950), pp. 196-207.

[38] Cottier and Homberger report, p. 58.

higher classifications to the road services. German truck rates are regulated only by the regional governments (Länder). Enforcement is ineffective[39] so that there is something approaching free competition as far as entry and price cutting is concerned.

Induced by the pressure of highway competition, the Bundesbahn has undertaken a basic tariff reform directed toward reducing the spread between the highest and lowest classifications by reducing rates in the top classifications and symmetrically raising rates in the bottom classifications. The spread of European classifications is usually less than in this country where important commodity rates are often no more than 10% of first class rates. In prewar (and early postwar) Germany class G rates were 35% of class A. The 1950 tariff reform raised class G to 50% of class A. A few commodity rates appear nevertheless to be only about 10% of class A.[40] The French railways, by shifting their emphasis from demand to cost, have similarly undertaken a narrowing of the traffic spread.[41] These basic changes in the freight tariff structures are due more to the competition consequent upon the physical disruptions of war than to inflation. At the cessation of hostilities there was an acute shortage of transport facilities of all sorts. The more flexible highway services were often more quickly available than the rail lines; as organization was restored it was difficult to disfranchise those who had provided service in the days of greatest need.

The trucks, of course, sought out the most lucrative traffic, that is, the traffic with the least elastic demand for transportation on which the railways had established the highest charges and won it by price competition. The response of the railways' management in meeting price competition on the high-rated traffic is entirely rational, but to raise rates on the low-rated traffic is not a necessary concomitant. The low rates were presumably established because the demand for railway transport of those particular commodities was judged to be quite elastic. Raising rates on those articles will only produce additional revenue if the demand for transport of those commodities is now inelastic. There is no necessary symmetrical relationship in rate relationships between various commodities.

The developments in the German passenger field have been more complex than in freight. Passenger traffic is relatively more important to European railways than to American railways. To the latter, passenger revenues are usually about 10% of total operating income. In 1949 the Bundesbahn received 36% of its revenue from passengers; the year before the passenger contribution was 40%.[42] Prior to the currency reform about three-fourths of the revenue came from passenger traffic.[43] Prior to the currency reform, however, passenger traffic was inflated by passengers searching out barter transactions, various forms of refugee and military travel, and also by the fact that transportation, even though of greatly reduced quality, was one of the few things which could be bought at prewar prices. Freight traffic, on the other hand, like the other aspects of production, was kept to low levels by the social disruption and physical destruction of the country.

The passenger rate structure is complicated by the existence of many specially

[39] Coverdale and Colpitts report, p. 67.

[40] Cottier and Homberger report, pp. 60-72.

[41] Goursat, "New Goods Rates of the French National Railways," *Transport and Communications Review*, January-March, 1949, p. 28, and April-June, 1951, p. 12.

[42] Calculated from data in Deutsche Bundesbahn, *Anhang zu Statische Angaben . . . ., sup. cit.*, pp. 22 and 25.

[43] Calculated from data in Coverdale and Colpitts report, pp. 27 and 40.

reduced rates granted to workmen and students, essentially for commutation. Reductions from the basic fare may be as great as 91%, as in the case of a single student, with an additional 50% off the remaining fare for brothers and sisters who are also students.[44] Together these commutation tickets account for 29% of the passenger-kilometers of the Bundesbahn, but only 10% of the passenger revenue.

In 1946 standard fares were doubled, and special commutation fares increased 50%. The latter increase was rescinded, however, during the following year. After currency reform, standard fares were reduced 25% and various promotional fares were introduced. The basic German fares, in pfennigs per kilometre, appear in Table I.[45]

TABLE I

CLASS	1932–46	1946–48	1948–51	1951	Increase 1932–51
First.....	8.7	17.4	13.1	13.8	58%
Second.....	5.8	11.6	8.7	10.35	79%
Third.....	4.0	8.0	6.0	6.9	72%

Sources: Columns 1, 2 and 3: Cottier and Homberger report, pp. 49-50; Columns 3 and 4: Deutsche Zentrale für Fremdenverkehr, Reisemerkbuch Deutschland (Frankfurt am Main: 1951), p. 24 and Supplement, p. 6.

In addition to the basic inland fares, supplements are required for the use of most fast trains. The amount of the supplement depends on the class of travel, classification of train, and distance of travel, except that for the fastest trains an additional flat super-supplement is charged.

International fares were, until 1951, on a tapering scale and not directly comparable with domestic German fares; short distances being higher and long distance lower. International fares include the supplements for fast trains, so that the average may well have been less than the domestic fares. On December 1, 1951, when domestic fares were last increased, international fares were established on the same distance scale but fast train supplements were included so that for fast trains international fares are lower per mile than internal by the amount of the supplement.[46] In the Russian zone the Reichsbahn doubled the prewar fares in 1946, as was done in the western zones but, since there was no direct currency reform in the east, the 1948 reductions were not made. In the summer of 1951 Soviet zone fares were at the level established in 1946, payable in westmarks in west Berlin and in eastmarks elsewhere.[47]

The cost of living in Germany, which had sagged in 1949 and early 1950, began rising after the Korean incident. In November 1951 the cost of living index stood at 169 (1938 equals 100).[48] Since the passenger fares shown in column one of the above table were in effect in 1938, and those in column four became effective December 1, 1951, it is clear that railway fares have risen, if irregularly, to a present level closely in step with the cost of living. That is in contrast with most countries, including the United States, in which transport charges have failed to keep pace with the rise in other prices.[49]

The quality of passenger service has substantially improved during the postwar period; the number of train-kilometres almost doubling from 1947 to 1949, while the average number of passengers per train declined from 442 to

[44] Cottier and Homberger report, p. 52.

[45] Deutsche Zentrale für Fremdenverker, *Reisemerkbuch Deutschland* (Frankfurt am Main: 1951), supplement p. 6.

[46] *Ibid.*, p. 20, and supplement, p. 1.

[47] *Amtliches Kursbuch, op. cit.*, (1951), p. 12.

[48] *Wirtschaft und Statistik, op. cit.*, December 1951, p. 501.

[49] In the United States, rail fares rose only 33% from 1942 to 1950. (Interstate Commerce Commission, *Monthly Comment on Transportation Statistics*, November 14, 1951, p. 12). Between 1938 and 1942 they rose 15% (Ex Parte 148, 248 I.C.C. 545, 255 I.C.C. 502). Thus in 1950 United States rail fares were 53% above prewar, while the cost of living was 70% above.

136. This shift toward higher costs coupled with declining revenues has been criticized,[50] but in 1947 the quality of services must have been extremely low. (It should be remembered that few American trains, other than commutation, carry 442 passengers.)

Between 1949 and 1951 it would appear that the trend has been toward more frequent but smaller trains, since the count of trains on the sample day seems to have risen moderately (perhaps 25%) while the gross tonnage of passenger trains has risen only slightly (perhaps 10%).[51]

Although data for exactly comparable time periods are not at hand, train timings are pretty much back to prewar standards in western Germany. Table II shows the elapsed time of the fastest-scheduled day trains[52] between certain major cities.

In summation, passenger price policy on the Bundesbahn could be described as generally rational. Basic mileage fares now have been adjusted closely to the same position, relative to other prices, as existed before the war. The use of mileage as the foundation of passenger fares instead of some measure related to the elasticity of demand can be criticized; but most countries of the world base their fares on distance, partly because of the ease with which passengers can buy either combinations of tickets or alight short of destination. However, the Bundesbahn does offer local round trips between certain stations at fares based on the elasticity of demand.

TABLE II

	1951	1950	1938
Köln-Frankfurt	2'49"	3'01"	2'48"
Köln-Hamburg	5'59"	5'51"	6'02"
Köln-Munchen	7'26"	10'12"	8'53"
Köln-Berlin	11'36"	11'17"	5'33"
Köln-Basel	6'23"	8'05"	5'40"
Frankfurt-Bremen	6'27"	6'03"	5'41"
Frankfurth-Berlin	12'02"	11'57"	5'05"
Hamburg-München	9'54"	12'56"	11'49"
Frankfurt-München	6'12"	6'32"	5'11"
Berlin-München	17'19"	17'22"	6'44"

Sources: Deutsches Kursbuch, Winter 1938; Amtliehe Kursbüeher, Winter 1950, and Summer 1951.

Freight rates have been handled less rationally than passenger fares. That is, the railway administration has failed to raise them as rapidly as other prices have risen. Rates on commodities at the lower end of the classification have gone up some 62% since before the war; on on the other hand, high-rated articles now pay only 13% more than before the war. In the United States too, rates in general have not risen proportionately to prices, but the distribution of the increases has been the obverse of the German; with the greatest increases on manufactures and similar highly rated articles. Offhand, one would expect the German practice more likely to be an appropriate evaluation of the elasticity of demand for transport than the American. That is, one would expect that the sources of raw materials are pretty much fixed by natural factors, while the location of manufacturing is variable, and hence rates could be raised more successfully on raw materials than on manufactures. That would be particularly true on commodities such as coal for domestic use. As soon as it is a question of raw materials for further processing, many other factors, mostly not directly related to transport, become operative.

III

A final word is perhaps necessary on the relation of the Bundesbahn to the German government. After the first war the railways of the German states were

[50] Coverdale and Colpitts report, pp. 152-153.

[51] *Streckenbelastungskarten, op. cit.*

[52] Day trains are usually faster than night trains. The fastest train is often a diesel rail car with early morning departure and midday arrival. Such trains do not usually provide service in all three classes; supplemental fares are applicable.

combined and nationalized to be operated as an independent economic enterprise. During the reparations period the railway management was separated from the central government but after the seizure of power by Hitler the railways were operated directly by the Ministry of Transport. The legal situation immediately following 1945 is obscure but apparently the railways were considered to be the property of the Länder. Control seems to have passed from the ministries of transport of the Länder to that of the bizone and finally to that of the Bundesrepublik. In all of this, the position of the railway as an economic entity, financially independent of government and managed in accordance with business principles, has been preserved.[53] This situation produces some difficulties.

First, while Coverdale and Colpitts are not concerned about the relation of the railway to the republic, Cottier and Homberger desire to see the railway continued as an independent business unit without government subsidy.[54] Secondly, both railway surveys seem to agree on the necessity of a substantial curtailment in the number of employees.[55] Finally, there is agreement that the state of maintenance of way and structures leaves much to be desired, and the increase in derailments from 0.46 per million train kilometres in 1936 to 5.17 in 1946, and 1.14 in 1950, is cited as evidence, along with data on rail fractures, of the need for work on track and way.[56]

Much of this increased maintenance could be done by labor alone, or requires only ubiquitous materials such as sand or cinders. Unemployment in Germany since the currency reform has been of the order of magnitude of 10% of the labor force, ranging between 1.2 and 1.8 million in a labor force of 13.5 to 14.9 million.[57] Employees displaced from the railway would be unlikely to find alternative employment, and hence would fall onto the relief rolls. Moreover, the Bundesbahn employs more than half a million,[58] or more than 3% of the labor force.

It is objected that for the railway to proceed to make good its under-maintenance—the deficit to be made up by government contributions—would be inflationary. To the Germans, having experienced inflation twice thus far this century, that is a damning threat. However, it is not obviously the case that to maintain workers on relief rolls generates much less income than to maintain them on track gangs. That depends, obviously, on the level of payments in each case. But in the latter case, some additional output is made possible, which output could well be large enough to absorb the difference between the income generated by relief payments and that generated by manual labor on track gangs. Railway management wishes to avoid both losses and subsidies, and the allocation of relief monies toward payment of maintenance gangs seems to have received little or perhaps unfavorable attention.

We may conclude the Bundesbahn has shown good judgment in handling its immediate production problems, particularly those of the changed relationship between cars, locomotives, and labor, and has shown reasonably good judgment in its pricing policy. But on the broader social policies there are still indications of a failure to distinguish clearly between the purposes of private business and public government. It must be remembered that Hitler did not make that mistake.

[53] Cottier and Homberger report, pp. 1-11.
[54] *Op. cit.*, p. 194.
[55] Coverdale and Colpitts, App. A., p. 11; Cottier and Homberger, p. 201.
[56] Cottier and Homberger report, p. 125; Coverdale and Colpitts report, pp. 90-92.
[57] *Wirtschaft und Statistik, op. cit.*, December 1951, p. 1157.
[58] *Wirtschaft und Statistik, op. cit.*, December 1951, p. 483

Forest Production Goals: A Critical Analysis

By HENRY J. VAUX* and JOHN A. ZIVNUSKA*

"TO furnish a continuous supply of timber for the use and necessities of citizens of the United States"[1] became an objective of Federal policy in 1897. Since then, one of the central problems of a public forest policy has been to determine how large a supply of timber should be grown to meet these necessities. Although it has not ordinarily been identified as such, the emergence of this problem represented one of the earliest excursions of government into the economics of production goals, a function which has since been extended to much broader fields.

The development of production goals as guides to public forest policy is thus of peculiar interest because it involved a pioneer effort on the part of government in an area of economic policy which has become of increasing political and economic importance. The purpose of this article is to review the development of production goal concepts by the Forest Service, to criticize these developments from the standpoint of the logical function of such goals in economic planning, and to indicate the conditions which must be satisfied by a more complete model of a forest production goal. The analysis may be useful, not only in an evaluation of certain current issues in forest policy, but also in relation to comparable issues concerning other natural resources.

I

Early recognition of the problem of production goals in forestry was in general rather than in specific terms. Beginning in the 1870's a few far-sighted individuals saw clearly that the then existing physical surplus of timber represented a relatively transient state of affairs. They understood that, if the opposite sort of economic maladjustment were to be avoided in the future, immediate effort was needed to place forest land in productive condition. The problem was to raise forest production[2] from practically zero to some substantial quantity. So long as no timber forestry was being practiced the question of what level of productivity should be achieved was largely academic. Accordingly, the early emphasis by leaders in forest conservation thought was on stopping forest devastation and on getting some forest production under way. A goal of "more production" was sufficiently precise for the needs of the time.

As progress was made in this direction, the need for a more accurately defined production goal arose. Rough data on long-run timber supply (in terms of current growth) were becoming available, and such quantitative information had to be evaluated in the light of the policy of furnishing a "supply of timber for the use and necessities of the citizens of the United States." One of the earliest quantitative bases for such evaluation involved the comparison of current growth with current drain. Thus, Secretary Meredith reported to the President in 1920 that "we are using timber four times as fast as we are growing it."[3] During the ensuing thirty years comparisons of current growth with current drain have frequently been used to

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[1] Act of June 4, 1897 (30 Stat. 35); sec. 475, title 16, U.S.C.

[2] Throughout this paper "forest production" means growth of wood. It does not refer to conversion or utilization of standing timber.

[3] U. S. Forest Service, *Timber Depletion, Lumber Prices, Lumber Exports, and Concentration of Timber Ownership*, Report on Senate Resolution 311 (Washington: Government Printing Office, 1920), p. 3.

diagnose the general health of the forest economy.[4] "Drain ratios" (ratio of current drain to current growth) in excess of unity have been cited as evidence that increased forest production was needed.

When rigidly applied, the drain ratio concept implies a production goal equal to the sum of current wood use and losses to forest enemies. The difficulties inherent in such rigid application of the drain ratio have long been recognized. For example, a substantial proportion of the growth in any stand takes place on trees of less than merchantable size. The volume of such growth cannot be directly compared with the volume of harvested trees of merchantable size. If board foot units of measure are used, growth on the small trees may be omitted entirely. If cubic foot units are used, we ignore the fact that 100 cubic feet of new wood distributed over 100 small trees is not the precise equivalent—silviculturally or economically—of 100 cubic feet of wood harvested from a single large tree.

A second difficulty with the drain ratio is that it indicates what is happening to the total volume of growing stock, not what is happening to the growth capabilities of that stock. Thus, wherever virgin stands are being cut at even moderate rates a large excess of drain over growth *must* appear initially. Reduction in the total volume of stock (excess of drain over growth) is a necessary condition to increasing the growth under these circumstances.

Finally, the drain ratio is ineffective as a diagnostic tool because it ignores the question of the appropriate *level* of yield. Growth and drain could conceivably be in balance with annual growth either at 1 billion board feet per year or at 100 billion. It is vitally important to have some idea of where within this range the balance should be struck. Indeed, this is the fundamental question at which production goal analyses are directed. But on this matter drain ratios throw no light whatsoever. Because of such problems as these there has been an increasing tendency to use the drain ratio as only one of a number of indicators of the forest situation.[5]

The McSweeney-McNary Act (1928) clarified considerably what Congress meant by its earlier policy of furnishing supplies for "the necessities of the citizens," and at the same time provided the means for more intensive study of the subject. Section 9 of the Act charged the Secretary of Agriculture with the responsibility of making "a comprehensive survey of the present and prospective requirements for timber and other forest products in the United States, and of timber supplies, including a determination of the present and potential productivity of forest lands therein, and of such other facts as may be necessary in the determination of ways and means to balance the timber budget of the United States."[6] Here was a clear statement of the goal of timber production policy, defined in terms of present and prospective balances between demand for timber and forest productivity.

Since 1928 the Forest Service has periodically published appraisals of the forest situation, based in part on the Forest Survey authorized by the Act, which analyze the long-run aspects of

[4] e.g., in U. S. Forest Service, *A National Plan for American Forestry*, Senate Doc. 12, 73rd Cong., 1st Sess. (Washington: Government Printing Office, 1933); and in U. S. Forest Service, *Forests and National Prosperity*, U. S. D. A. Misc. Pub. No. 668 (Washington: Government Printing Office, 1948).

[5] However, the most recent nationwide drain ratios, showing drain of all classes of wood only slightly in excess of growth, have been interpreted by some groups as meaning that the forest production goal has been substantially achieved.

[6] Sec. 9. Act of May 22, 1928 (45 Stat. 699), secs. 581 a-i, title 16 , U.S.C.

balancing the timber budget.[7] Each of these has presented figures for the drain ratio as of diagnostic value. But the Service has continually tried to develop a more critical type of analysis and more satisfactory long-run quantitative goals for forest production. In these reports increasing emphasis has been laid on long-run future "requirements"[8] as the basis for determining the growth objectives which are fundamental to program planning. The programs recommended in each case were those which, in the opinion of the Forest Service, would lead to future production of timber in the amount of estimated future "requirements," due allowance being made for a safety margin. Thus the Forest Service has regarded its requirements concept as the major ingredient of a forest production goal.

II

Before turning to an analysis of requirements, a clear distinction should be drawn between two different applications of the term which have appeared in practice. World War II gave substantial impetus to study by the Forest Service of current and short-run requirements for forest products.[9] The purposes and orientation of this sort of requirements analysis are very different from those of requirements studies underlying appraisals of the long-run forest situation.[10] During any brief period of years, and particularly in a war economy, the facilities available for converting stumpage into lumber and other products are sharply limited, and the total supply of standing timber is relatively fixed. Under pressure of wartime demand, and with the need to allocate these inelastic supplies to the most pressing uses, it is necessary to know something about the quantity of short-run demands for wood, and the urgency of such demands relative to the military program. The objective of wartime and other short-run requirements studies is thus to provide information on how to divide up the existing forest-products pie. In contrast, long-run requirements studies, if they are to be of use in determining production goals, must be oriented to the question of how big a pie we ought to bake for the future.

In order to avoid confusion on this point, this paper will follow the distinction made by Rettie[11] and will use the term "potential requirements" to identify the concept as used in production goal determination.

III

We now consider the adequacy of the potential requirements concept as the basic determinant of production goals in forestry. It should be emphasized that this discussion is limited to the conceptual level and does not consider the operational problems of implementing the model. Thus the *validity* of recent forest requirements estimates is not here in question, but their *significance* will be closely scrutinized.

Rettie and Hallauer[12] define "potential timber requirements" as "the quantity of timber products that might

[7] U. S. Forest Service, *A National Plan for American Forestry*, *op. cit.*, R. E. Marsh and W. H. Gibbons, "Forests Resource Conservation," *Yearbook of Agriculture, 1940* (Washington: Government Printing Office, 1940); U. S. Forest Service, *Forests and National Prosperity*, *op. cit.*

[8] Terminology varies. Senate Document No. 12 used "requirements;" the 1940 Yearbook "possible future consumption," and Miscellaneous Publication 668 "potential requirements." The basic concept, in each case, appears to be substantially the same.

[9] U. S. Forest Service, *Forestry in Wartime*, Report of the Chief of the Forest Service, 1942 (Washington: Government Printing Office, 1943), and subsequent reports of the Chief.

[10] James C. Rettie, "The Purposes and Basic Concepts of Timber Consumption and Requirements Studies," *Journal of Forestry*, April 1948, pp. 237-242.

[11] *Loc. cit.*

[12] James C. Rettie and Frank J. Hallauer, *Potential Requirements for Timber Products in the United States*, Report 2 from a Reappraisal of the Forest Situation, U. S. Forest Service (Washington: Forest Service, 1946), p. 1.

be used by consumers afforded reasonable latitude in choice of readily available materials, including timber products, in a national economy functioning at a high level of employment and output." They further stress that "these estimates are not forecasts of consumption" since actual future consumption may differ from requirements due to deficiencies in supplies.

Rettie, in a further expansion of the requirements concept, provides an alternative definition of "potential timber requirements" as "the quantity of timber and timber products which we would probably use at some future date under conditions of reasonably adequate supply."[13] He emphasizes that estimates of requirements differ from forecasts of consumption, since future consumption will be a function of actual future supply, and from statements of "needs," since such statements are subjective value judgments.

As has been discussed elsewhere,[14] due to the long period required for timber production and the peculiar nature of forest capital, prolonged periods of disequilibrium between the rates of production and demand may occur. In such a field of economic activity, the difference between a forecast of consumption and an estimate of potential requirements may be very large. The forecast of consumption is the amount that probably will be consumed with full allowance for the anticipated probable supply situation, while the estimate of potential requirements is the amount that probably would be consumed if supplies were adequate. The difference between the two estimates, then, is based on the difference between probable actual supplies and "adequate" supplies.

[13] Rettie, *op. cit.*, p. 241.

[14] John A. Zivnuska, "Some Aspects of the Economic Theory of Forestry," *Land Economics*, May 1949, pp. 165-172.

However, if "requirements" is to be a precise economic concept and is to be distinguished from the subjective statement of "needs," it is necessary to develop an objective measure of "adequacy" of supply. For the purposes of economic analysis the logical measure of "adequacy" is readily apparent. When the rate of production is in such a state of balance with the rate of consumption that the average costs of production equal the average selling price and the marginal costs of production equal the marginal selling price, supplies may be described as "adequate" since there is no economic incentive either to increase or to decrease production.

In short, the estimate of potential requirements, if it is to be economically significant, must be an estimate of the rate of production and consumption which would be characteristic of the long-run competitive equilibrium situation. While it may seem obvious when so stated that the goal of economic policy in production should be the equilibrium situation, the growth goal analyses which have been made to date give no explicit recognition to the implications of this fact for such work. This is surprising in view of the fact that the legislative charter for production goal analysis which was quoted above clearly gives equal and coordinate emphasis to the influence of *both* "prospective requirements" and "potential productivity."

IV

While this identity of potential requirements and the production goal with the equilibrium situation appears to follow logically both from Rettie's and Hallauer's definitions and, more generally, from the language of the McSweeney-McNary Act, the actual pattern of the Forest Service requirements analysis has been different. Although

there are procedural differences in the handling of the several types of wood products studied and even instances of apparent inconsistencies with the basic premises of the study,[15] the economic model of the study can be abstracted fairly readily.

The concept of "reasonable latitude in choice of readily available materials, including timber products" as used in the Reappraisal is interpreted in terms of an historical price relationship. While this base period is not specifically defined, it appears to be the period between the two World Wars. The estimate of potential requirements which is developed is, in essence, an estimate of the amount of wood which would be consumed if prices of wood and other materials hold in the future about the same relative positions as were typical of the period between the two World Wars.

The economic model of this analysis is extremely simple. The attempt is to determine a single point, X, on the demand schedule, representing the quantity which would be purchased at a price, Y, equal (in purchasing power) to that of the base period, with all other prices held constant at their corresponding levels. The validity of the results of such an analysis depends solely on the accuracy with which this point is determined. The significance and usefulness of the results, however, depend also on the adequacy of this economic conception.

That this is an adequate and useful model for production goal analysis can be challenged on four main grounds. These objections to the model can be introduced by reference to Figure 1 in which Y equals the base period price of the commodity for which potential requirements are to be determined, all other prices are held constant at their base period levels, and the objective is to determine the quantity which would be required or demanded at this price. This quantity will be defined by the intersection of the demand curve with the price line at level Y.

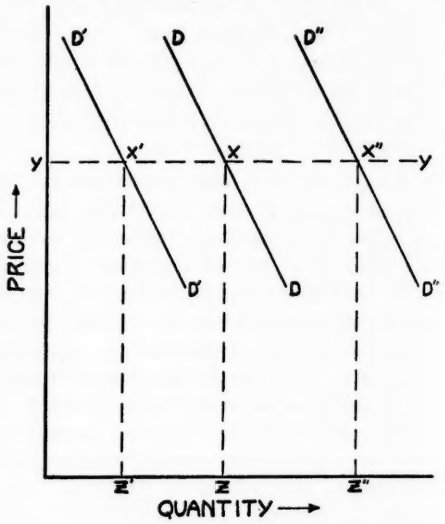

FIGURE 1

In Figure 1, DD, D'D' and D" D" represent only three of the infinite number of possible shapes and locations of the demand curve, and X, X' and X" represent corresponding possible positions of intersection between the demand curve and the price line. There is in advance no way of knowing that the desired point will fall at X rather than X' or X"—in fact, this is the question under investigation. Thus the assumption is necessarily involved that quantity Z, or Z', or Z" (in other words, any quantity) can be produced at a cost equal to price Y, since if the cost were less than Y the quantity would be less than adequate to meet the demand at the cost of production while if the cost

[15] e.g., the Reappraisal analysis of construction plywood seems to abandon the basic definition of potential requirements in favor of analysis in terms of supply alone. See Rettie and Hallauer, *op. cit.*, p. 43.

were more than Y the quantity would be more than adequate to meet the demand at the cost of production. In short, growth goal analysis based on this simple economic model of requirements involves the implicit assumption that the supply schedule can be represented by a horizontal straight line at a level corresponding to the selling price in the base period.

In the case of timber perhaps the most obvious objection to this assumption is the level at which production costs are placed. During the base period used in timber requirements analysis the supply of timber consisted almost entirely of virgin or volunteer stands, thus making it highly unlikely that the quantity of standing timber reflected any high degree of adjustment to the equilibrium requirement of equality between rate of production and rate of consumption. From this it follows that equality between cost of production and selling price of timber in this period is improbable, and so there would appear to be no reason for setting future costs of production at this level.

A more fundamental and universal objection, however, lies in the fact that this assumption implies that cost of production is completely independent of the quantity of production. This is not in accord with our general knowledge of the shape of the supply function, and there is nothing in our present knowledge of the costs of timber production to lend support to the concept of constant costs of timber production, particularly in "a national economy functioning at a high level of employment and output."

The third objection to this model is that it is static rather than dynamic. For application, it requires arbitrary selection of some particular period of time at which the balance between long-run timber supply and demand will be achieved. In the Forest Service's Reappraisal for example, the year 2020 was chosen as the target date. But the model supplies us with no means of knowing whether or not this is the optimum period over which adjustment should be made. There is no apparent reason why either 1970 or 2070 might not be just as good a target date for reaching the production goal. And the intervening patterns of production and consumption, the program needed to achieve the goal, and even the magnitude of the goal itself will vary widely, depending on the target date selected.

In more general terms, the trouble is that the model fails to recognize that both demand for and supply of timber products are continuous functions running through an infinite time continuum. A fully adequate production goal must be in terms of a continuous and not necessarily static balance. Potential timber requirements will change from decade to decade in response to basic changes in the timber supply situation, and there is no reason for selecting the requirements of one particular year or period of years as a goal in preference to those of some other period. What is needed is a solution which will reflect these dynamic features of the problem.

A final objection to this economic model lies in the assumption that all other prices remain at the same relative levels as in the base period. In a progressive economy subject to rapid technological change this is highly improbable. This problem, of course, is common to any case of specific equilibrium analysis as opposed to general equilibrium analysis.

V

The statement of the first two of these deficiencies in the economic model in itself suggests the nature of a somewhat more complete model.

This first revision of the economic model for potential requirements analysis

is, as shown in Figure 2, simply the familiar long-run equilibrium supply-demand situation. The objective of the analysis is now seen to be the determination of the point of intersection of the

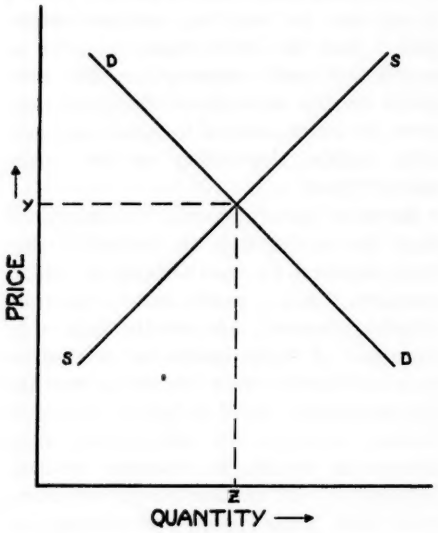

FIGURE 2

long-run demand and supply schedules. Instead of involving only the determination of a single point on the demand schedule at a predetermined price, the economic model requires the determination of both supply and demand schedules in sufficient detail to enable the simultaneous solution of both quantity and price of the potential requirements estimate through estimation of the point of meeting of the two schedules.

However, even in terms of specific equilibrium analysis, this model is still incomplete. Since the movement toward the equilibrium position requires time for its completion, the model for the analysis must include provision for secular effects. In the case of forest production in which changes in productive effort require decades to become fully effective this problem is especially significant.

The problem involved here lies in the fact that the final goal to be reached will be determined in part by the path which is followed in reaching the goal. This may be illustrated by further reference to the Forest Service Reappraisal project. In analyzing the measures necessary to reach the growth goal which was set, the Forest Service[16] concluded that even if a comprehensive program of forest production were started immediately, it would be necessary to reduce consumption below present levels for a period of years in order to reach the goal. This is due to the identity between the growing stock or productive factor and the stumpage or final product of forestry enterprises. Thus, in order to increase the volume of timber which is being produced, it is necessary to increase the volume of timber held as growing stock. Obviously, one means of increasing the volume in growing stock is to decrease the volume cut during the adjustment period. Necessarily, cut must be less than growth over any period in which growing stock is to be increased so that in time both growth and cut can be increased. Accordingly, if the growth goal is set at any level higher than the present rate of growth, then during the period of adjustment the average cut must be less than the growth goal will eventually allow. Whether or not cut must also be held below the current level of cut (which is higher than the current growth) will depend on the combined effect of the height of the eventual growth goal, the volume of the existing virgin timber reserve (which does not contribute to growth), and the effectiveness of alternative measures in increasing the growing stock.

[16] U. S. Forest Service, *Forests and National Prosperity*, *op. cit.*, pp. 40-45.

The problem which this involves for potential requirements analysis is due to the fact that demand at any point in time is not uniquely determined but is closely related to past demand and the degree to which such past demand has been satisfied. We must think not only of potential requirements at some distant point in time at which the production adjustment will be complete but also of the entire time sequence of requirements —the amounts which would be purchased if supplies were available at the cost of production—throughout the adjustment period. To the extent to which meeting the growth goal makes it necessary to hold the cut below the level of this time sequence of requirements, timber will be in scarce supply and a scarcity price will obtain during the adjustment period. In a technologically-active economy such scarcity prices can be expected to induce the development of alternate materials, modification of utilization techniques, and even changes in consumers' preferences which would not otherwise have occurred. Thus the effect of scarcity at any stage of the adjustment period will be to shift the demand curve of all future periods to the left of where it would have been in the absence of such scarcity.

For example, in Figure 3 let D′ be the estimate of the demand curve with no allowance for the effects of intervening periods (since the extent of such scarcities cannot be estimated until the size of the growth goal is determined). Q′ would then be the corresponding quantity for the growth goal. It may then be estimated that the scarcity periods in reaching this growth goal would shift the demand curve to D″, with Q″ as the corresponding growth goal. Now, however, the intervening shortages would be less than estimated for Q′, so it appears that the demand curve would not be shifted as far to the left as D″. Through a series of such successive approximations the final position of the demand curve at D could be

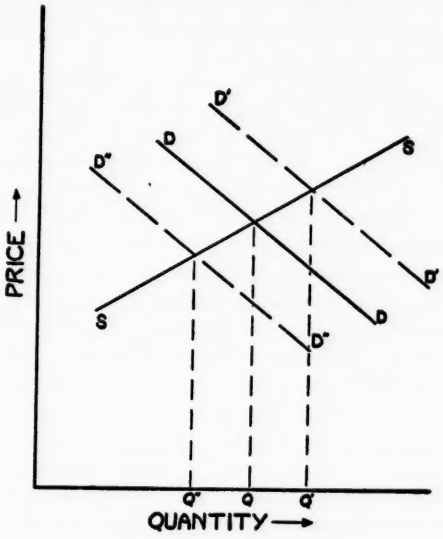

FIGURE 3

determined and the approximate growth goal Q set.

VI

In view of what has just been said of the dependence of demand in a given period on the consumption of other periods, we may logically ask, "Is the supply function in the model of Figure 2 subject to analogous intertemporal effects?" The answer of course is "Yes." The schedule of quantities of timber which, at some future target date, can be made available at various alternative levels of cost is related to the quantities which will be produced at all other dates between now and the target date. This is so because of the dual economic nature of standing timber—it is both capital plant and finished product. As a result, an increased (decreased) production of finished product during any period of time may lead to a reduction

(accumulation) in the capital plant available for production in subsequent periods, and hence may affect costs and supply in such periods. The implications of this situation may be visualized in terms of an illustration.

Suppose that we wish to establish a timber growth goal for the year 2020, to be used as a guide to timber production programs. In conformity with the model of Figure 3, we attempt to forecast demand for 2020, taking account of secular demand influences in arriving at the desired function, DD. But to do this we must estimate consumption for each of a series of convenient time periods between now and 2020. These estimates will depend on the position of the demand and supply curves during each of the intervening time periods. Because of intertemporal supply and demand relationships, their positions will depend on the level of production in preceding periods.[17] In other words, an economic model for growth goal determination which takes account of relevant dynamic and secular effects must provide a solution of the "moving equilibrium" type in which the optimum level of production for any future date is estimated simultaneously with estimates of the optimum level of production at all other future dates. If this condition is not met, there is no guarantee that the estimated goal will increase net returns to society, much less maximize them.

A solution of the type just decribed eliminates the difficulty inherent in picking some particular future period as the target date for growth goal determination. It provides for a balancing of supply and demand at all future dates, and would yield goals appropriate for each and every future period. Obviously, the model would have to provide for some form of weighting, if only in recognition of the fact that contingencies which are very remote in time are less significant for public policy than those of the same order which are more immediate.

Derivation of a solution of this sort will be fraught with other difficulties both theoretical and practical. But these do not at present appear to be insurmountable. The problem is an important and challenging one for those who are concerned with guiding public forest policy as well as for those who are attempting to make economic analysis a more effective tool for policy evaluation.

VII

This discussion of potential requirements analysis has been developed within the specific equilibrium context. The objection that the Forest Service model assumed that all other prices remain at the same relative levels as in the base period remains to be considered. This objection could be met fully only by setting up the model in the context of general equilibrium analysis, a procedure which lies beyond the scope of this paper and of most potential requirements studies. Some recognition can be given to this problem, however, in developing the demand and supply schedules. Available evidence indicating significant trends in the relative level of prices of any of the close competitors could be developed, and suitable allowance made for the probable effects in determining the demand curve for the product under study. Allowance could similarly be made for any known trends in important cost items in developing the supply schedule.

VIII

The objection may be raised that the type of model for potential requirements analysis described here would involve so many technical difficulties on the operational level that the analysis would fall of

[17] Also, where expectations influence the situation, supply and demand in a period will be influenced by expectations of market conditions in future periods.

its own weight. Certainly it must be admitted that even the rudimentary model used by the Forest Service resulted in many complexities operationally. However, it is possible that the difficulties involved in this more complete model may be exaggerated.

In any case, it is the soundness rather than the simplicity of the analysis which is the more pertinent issue. It would be surprising if significant conclusions could be drawn for production policy from an analysis which ignores production costs. Only when the theoretical framework of analysis is fully understood is it possible to develop a well-balanced operational program of analysis and to evaluate adequately the results which are obtained.

Among Articles Scheduled for Future Publication

Housing Rent in Soviet Russia ..... *Maurice Frank Parkins*
Accelerated Amortization and Regulatory Policy ..... *Edward Neuner, Jr.*
Administration of Grazing Districts ..... *J. Russell Penny* and *Marion Clawson*
The Financing of Land Redistribution ..... *V. Webster Johnson*
Agricultural Prospects in the U.S.S.R. ..... *Naum Jasny*

Housing Standards and Housing Research

By RICHARD U. RATCLIFF*

THE subject of housing standards is interwoven into the whole fabric of the housing problem; in fact, in the absence of the concept of standards, there is no housing problem. Minimum housing standards are incorporated by law and regulation in local police power controls. The whole public housing controversy stems from differences in the levels of housing quality which are assumed to be socially tolerable. Standards appear in the concerns of builders and bankers who must interpret design features in terms of market demand or mortgage risk. The architects, the legatees of centuries of professional effort to relate design features to human requirements, are crying for a more realistic scale of values.

The term "standards" has acquired many connotations but most frequently implying minimum situations, with the situations expressed in physical terms. It is the purpose of this discussion to give emphasis to the point that the only standards which have relevance in housing programs are those which have their basic expression in human values, and that the concept of standards has meaning at all levels of housing quality.

As a starting point for the discussion of housing standards, let us look at the essence of housing. Housing is both a situation and a process. As a situation, housing is a current set of relationships between a person or group of persons of given biological and cultural attributes and a certain immediate physical environment—the structure and artifacts—together with the associated parcel of land and the land uses, individuals, groups and activities which comprise the community. Viewed dynamically, housing is a process. It is a process of investment, a process of the production of usable space by land developer, building products processor and manufacturer and home builder. It is the workings of the market which bring together buyer and seller, landlord and tenant. It is a process of utilization and consumption by the occupants of housing space. It is the evolutionary development of the community environment as a physical and cultural complex. It is the continuing change in social institutions which regulate land use and condition the way of life.

The problems of housing lie in the unsatisfactory living situations of individuals and families; the cures can come about by evolutionary or socially-induced modifications of the housing situations and housing processes.

To appreciate the role of standards in housing, consider the steps in the provision of housing space. All but a small proportion of housing is provided as a business proposition by investors and merchant-builders. The builder is interested in the immediate sale and thus attempts to interpret the design preferences of current purchasers. He picks that segment of the market which promises the liveliest sales and attempts to anticipate the combinations of space allocation, design features and equipment items which will be preferred by his customers within the limits of their financial capacities. Because few home buyers can afford all they would like to have in a house, the builder tries to foresee what the typical pattern of compromises will be.

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The builder will be inclined to interpret the prompt sale of his houses as verification of his choice of planning standards. Such a conclusion may not be justified; it proves only that the houses could be sold. It might well be that, as in recent years, the sales simply reflect the housing shortage. In other cases, locational advantages may have been great enough to offset planning deficiencies. Finally, the experience and observation of the buyers may have been so limited that they were not aware of the range of alternative design features which could be available to them without increased cost.

In practice, the builder is restricted in setting the planning standards of the homes which he builds. He is limited by the attitudes of the banker from whom long-term credit must be secured. Because the banker takes the long-view of mortgage risk considerations, his scale of values is somewhat different than that of the builder, who tries only to interpret the present market; the banker is inclined to be more conservative. In addition, when the mortgage is to be insured or guaranteed, FHA or VA standards are applied.

Building codes, zoning ordinances and other local regulations constitute another set of limitations within which the builder must make his decisions on design standards. Here, in these regulatory codes, we find the product of what is technically a democratic determination of standards. But it is well known that these standards typically are determined without benefit of adequate objective measurements.

A primary objective of housing legislation and housing programs is to raise housing standards, to modify or create housing situations so that they are acceptable. Housing standards which are incorporated in police power controls or which are implicit in the assumption that the public housing device is necessary, are standards of minimum social acceptability. In the case of police power regulations, few economic considerations are involved; there is little weighing of the cost of attaining the minimum standard. Where public housing is to be provided as the alternative to unacceptable housing conditions, society undertakes a financial burden in order to free certain of its members from intolerable living conditions. Where private choices are made by families above the subsistence level but below that level of wealth which requires no abstinence, housing standards are established by a complex balancing of values over the whole range of alternative allocations of available funds. The housing situation which results from this process of private decision does not necessarily, nor even typically, reflect the minimum levels acceptable to the family nor the maximum levels of full satisfaction.

Enough has been said up to this point to demonstrate the inadequacy of that popular connotation of the term "standards" which is limited to the notion of "minimum" standards. Minimum standards are not effective absolutes. True, we might agree that a line could be drawn around those housing situations which will inevitably kill off the occupants or assure an epidemic, but this is a practical absurdity. Housing situations involve degrees of probability that some undesirable results will ensue—fire, accident, ill-health, insanity; or on the other hand, that favorable results will develop —contentment, comfort, health, aesthetic satisfaction. To set a standard, or to make a choice in respect of some housing attribute we should have a measure of the human reactions to varying degrees of the attribute, such as the incidence of TB under varying levels of ventilation and

sunlight. Having a measure of these relationships, the minimum acceptable window area would be automatically established by the minimum acceptable TB rate. But note that the minimum TB rate is not a scientifically determined absolute, but a human choice based on considerations which go far beyond housing. Nor are the FHA or PHA minimum standards on room sizes more than a consensus of experts who combine their judgments on how people prefer to live and how they ought to live.

It is clear that the basis of standards determination is found in human values. We all know that houses are built for people and that the basic test of housing quality lies in the effects upon people. It should follow, therefore, that the judgments of housing situations, of space and space arrangements, of design features and equipment items, of neighborhoods and environments are only valid when related to the people and families who are exposed to them. It is shocking, therefore, to contemplate the continued setting of standards by legislative act, by judicial decision, by administrative determination, by the business judgments of builders and bankers, by the pencils of architects and land planners, by the unenlightened or forced choices of consumers, standards which irretrievably determine the housing destinies of our people for decades to come, standards which may perpetuate socially-dangerous living conditions for millions of families, all without benefit of a valid measurement or real understanding of the true impact of housing attributes on physical and mental well-being. How can we hope to evaluate the housing problems of of this nation, let alone solve them without such understanding?

The measurement of the impact of housing attributes on human beings is a complex and imposing task. Yet, because it is central to the objective of raising the level of housing conditions and reducing housing costs, it must be undertaken by those who have faith in the instrumentality of research in accelerating social progress. Somehow the available studies which purport to demonstrate the relationships of housing and health are not very convincing. The association of slum conditions and abnormal morbidity rates, of housing blight and high indices of social disorganization can be established without throwing much light on direct causal relationships. Medical science must devise better techniques for isolating the relationships between specific housing features and specific physical ills. Psychological and social science must find methods for dealing with the even more complex problem of the measurement of mental health and attitudes.

There appear to be two categories of standards involved in the multiform problems of housing—which we might label "minimum" and "volitional." An important distinction lies in whether they are matters of the social conscience.

Minimum housing standards are those levels of living, directly determined by housing situations, which are no more than just socially acceptable. Whether these standards be codified in local housing regulations or administratively determined under broad definitions as in the public housing program, the process is one of democratic decision. Presumably the decision is based upon knowledge of how certain housing situations affect human beings. Actually this knowledge exists in only the crudest of forms, if it exists at all, and the standards which are established are expressed as physical specifications and not as levels of living.

Volitional housing standards reflect living situations which are generally in excess of levels of minimum social

acceptability and which apply in the housing situations of families above the subsistence level, where choice exists over the whole range of expenditure. Here the standard is not one set by formal democratic devices to forestall deplorable living conditions; these are standards which represent the choices of consumers to whom a range of choice is open. A volitional housing standard is a design or equipment feature which, for the consumer, yields the optimum satisfaction, all other alternative expenditures considered, within a given total of available income.

The major criteria in determining volitional standards are related not alone to the functions of housekeeping and family life but also to the culturally-determined value systems against which design features are judged.

We have already considered some of the ways in which volitional standards are determined in practice, and we recognize that for the most part such housing standards are voluntary but not necessarily enlightened. The practical problem for the researcher is how to develop design criteria, based on human reaction to housing features and combinations of housing features, which will guide householders to wise choices and which will thus ultimately influence the banker and the builder and the various governmental regulatory agencies.

Lest there be confusion over the term "design criteria," we might consider an example or two, over-simplified to make the point. The prospective home owner is sometimes presented with the choice of designs involving a front door entering directly into the living room with a vestibule or one with no vestibule. He must judge the advantages of a vestibule against the cost. He should be provided with objective measures of the advantages of a vestibule if he is to make a wise choice. How many times will the front door be opened under situations when there is a temperature differential between outside and inside? How much temperature change is involved with and without a vestibule; how significant is this change in terms of comfort and health, and the utility of parts of the room near the door? What is the effect in extra cleaning effort and in damage from wet and snowy feet, from rain and snow blowing in when the door is open? All of these factors can be subjected to analysis and some of them measured with fair accuracy.

Another choice often encountered is between a separate dining room and a living-dining combination room. Here cultural and practical considerations are combined. There can be measurement of the extra steps required in the case of a separate dining room, of the reduction in sizes of other rooms which would be required; the extra furniture requirements and added maintenance in effort and money cost. But these disadvantages may be outweighed by a cultural background and a way of life in which formal dining ranks high in subjective value. There can be no direct measurement of those values, but other measureable considerations can be presented in such a way as to be useful to those who must make the choice.

Perhaps we could classify design criteria which are relevant to volitional housing standards as: cost criteria, functional criteria and personal-cultural criteria. The cost is the dollar cost of providing the feature, sometimes in terms of alternative costs or cost differentials. Functional criteria relate to the utilization of the feature and the complementary effects on other features, measured in terms of effort, comfort, health, safety. Personal-cultural criteria are subjective, and largely culturally derived.

How can the research instrument be used to develop design criteria? The first step is to develop the measures of those criteria which can be expressed in quantitative terms—cost, for example, where comparative costs of alternative features can be determined. Many of the functional criteria can be quantified. Some of them can be expressed in terms of relatives to generally accepted standards. In other cases, a ranking of the functional qualities will be possible.

The culturally-derived reactions to design and equipment features carry us into the realm of consumer preferences. The measurements are behavioristic in dimensioning; they are in terms of reactions and observed choices or what sociologists refer to as norms. To be useful as design criteria, these norms must be related to the cultural and economic characteristics of the group under observation in order to be applied to housing intended for occupancy by groups of similar cultural and economic characteristics. The research problem of deriving design criteria which are relevant to volitional standards boils down to the development of a quantitative base for those consumer decisions which involve cost and functional considerations, and the observation and analysis of how these objective values, in connection with culturally-determined values, motivate consumers in their final combinations of choices. Ideally, the observation of final choices should be directed to consumers who have available for their consideration the results of the quantitative analyses.

The TVA and the Tennessee Valley—What of the Future

By HARRY A. CURTIS*

WE who are employed by the TVA, and therefore deeply preoccupied with its manifold activities, recognize clearly how important it is that we maintain a sound perspective as to the role that the TVA has played and will continue to play in the march of events in the Valley. It is particularly important that the part played by the TVA be not overrated, for to overrate the TVA's part paves the way for just criticism and lessens the opportunity to work effectively with others, while to underrate the TVA's role weakens the morale of the organization and thereby lessens its potential possibilities. Somehow, sound judgment must be reached as to aims, possibilities and achievements; and this is by no means easy to come by for human beings are essentially emotional rather than logical and good judgment is not a very common human attribute.

There are no doubt a few overenthusiastic individuals who give the agency credit for bringing about nearly all the beneficial developments that have occurred in the Valley. They remind one of James Whitcomb Riley's treetoad that hollered for rain—he hollered and hollered until his throat was dang near busted, but, by golly, he fotched it.

Reflective judgment will lead to the conclusion that some of the improvements in the economic and social situation of the Valley would have come since 1933 if there had been no TVA. In these cases the most that can be claimed by the TVA is that it did not hinder their coming. On the other hand, many beneficial changes that have come in the Valley certainly would not have come except for the TVA or similar federal agency. Between the extreme categories of things that would have come anyhow and those that would not have come at all if there had been no TVA lie a large number of beneficial changes that probably would have come about slowly but actually came earlier and faster because of TVA's efforts.

The present article proposes to discuss the future of the TVA and of the Valley. It is trite to say that there can be no certainty in such forecasting. One can only study the trends observable in the recent past, evaluate the likelihood of their continuance, and consider what new factors may come into play in the future. For the purpose of such discussion three periods of time will be considered, namely, prior to 1933, from 1933 to the present, and finally the future.

People had occupied the Tennessee Valley for a long time prior to 1933. Fairly rapid settlement began in the closing decades of the 18th century. The economy that developed during the 19th century was largely agricultural. Cotton was the major income crop in the lower reaches of the Valley, with tobacco playing an increasingly important place in the eastern part. Industrial development lagged far behind that of the eastern and middle western states. The Civil War and its unfortunate aftermath further retarded economic development of the Valley, and largely replaced the plantation system by one of tenant farming at a subsistence level. Income per capita in the Valley lagged, and by 1933 was only 42 percent of the national

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average. The great Tennessee River system, potentially a priceless asset, was almost wholly undeveloped as a means of navigation and as a source of hydroelectric power. As of 1933 only 3 percent of the farms in the Valley had electric power available. Refrigeration was available in only a few of the larger towns and was, of course, entirely lacking in rural areas. The low incomes and general economic distress of the South made it impossible to develop educational institutions and public health facilities to the standards attained in most other sections of the United States. Of course, this is not to say that living conditions in the South were ever intolerable, or that no progress was made in a century. Such was far from the case. But it is a fact that, for a variety of reasons, the southeastern states had not shared in the general increase of wealth and standards of living attained in the United States as a whole.

In 1933 the Congress, recognizing that economic development of this region had lagged, and perhaps foreseeing a still further lag as other areas of the country surged ahead, created a special federal agency, the TVA, to bring to the Valley such aid in developing its natural resources as proved feasible.

The TVA Act, signed by President Roosevelt in May 1933, was in many ways an unusual piece of federal legislation. It set up an entity that was intended to have much of the flexibility of a private corporation yet possessed of the powers and prerogatives of a federal agency. The headquarters of the agency are not located in Washington but in the Valley; its board of directors and practically all its employees live in the Valley as citizens, sharing the advantages and disadvantages of the Valley environment. The TVA Act delegated an unusual degree of autonomy to the TVA; it placed both authority and responsibility squarely on the agency; it enumerated only a few required functions but opened the way to a very wide range of activities that could legally be undertaken at the discretion of the agency. It is correct to say that the essential characteristics of the TVA as it exists today, while conforming to the requirements and spirit of the Act, are basically the result of many decisions made by the TVA Board over the years since 1933. The TVA might have followed quite a different course than it did, and it will be pertinent to mention some of the TVA policy decisions which have, in large measure, determined the program of activities undertaken and the methods by which results have been sought.

From the beginning, the TVA has undertaken a broad and comprehensive program that seeks to mobilize all the natural and human resources of the Valley. It recognizes the fact that the economic and social situation of a region is the overall outcome of the interplay of many related factors, and that a change in any one factor will inevitably bring about changes in many other factors. The TVA believes that only an integrated and balanced program can be effective; the plan to move on a broad front may be cited as one of the early policy decisions that shaped the development of the agency.

Another basic policy decision, made early by the TVA, is that, wherever possible, it will utilize local state, county, and municipal organizations in carrying out its program. This decision rests on the conviction that the source of strength of a region lies within the region itself, within its own natural and human resources. A federal agency may help and encourage and accelerate the pace of local organizations, but no such agency can effectively replace or assume the

role of local organizations. Federal aid is like a blood transfusion; it may, for the time being, save a patient's life, but the continued survival of the individual still resides in the ability of his bone marrow to produce normal blood.

In looking over the situation in 1933, it was evident that there were a few big jobs that the TVA itself would have to do. One such was the construction of dams, reservoirs, power plants, and transmission lines. The dams and reservoirs that have been constructed now provide flood control on the main streams of the Valley to the degree planned, and the dams, locks, and reservoirs provide a 9-foot navigation channel, 630 miles long, from Knoxville to the mouth of the Tennessee River. Along this channel about 600 million ton-miles of freight move annually; the public-use terminals at Knoxville, Chattanooga, and Guntersville, built by the TVA and nursed through some lean years in the forties, have now been leased to private operators.

Aside from the power, flood control, and navigation activities the TVA has undertaken, with its own personnel, the utilization of the old Nitrate Plant No. 2 at Wilson Dam, now designated as the TVA Chemical Plant. Fertilizers and munitions are produced there, and a research program in support of these operations is carried on.

The TVA programs in forestry, agriculture, public health, recreation, education, and the like, are not carried out unilaterally, but in cooperation with, and often through, the existing state, county and municipal organizations.

The present article will not attempt to review each of the many TVA programs, but, in trying to see what the future may hold, there will be repeated references to the present status of such programs and in this way the progress that has been made since 1933 will be indicated.

The Future of Power Developments in the Valley

As of June 30, 1952, the power capacity of the TVA system was rated at 3,859,910 kw. This figure includes the capacities at the TVA hydro- and steam-electric plants, the Alcoa hydro plants that are a part of the TVA system, and the power from the dams on the Cumberland that is distributed by the TVA. The 20 billion kilowatt-hours of energy generated annually in the system is more than 13 times the amount produced in the Valley in 1933. There are at present two dams and hydro plants and five large steam-electric plants under construction, and additional turbines are being installed at some of the dams. The construction now authorized (July 1952) by the Congress will bring the system's capacity to about 9,600,000 kw by 1956, i.e., more than three times the capacity as of June 1951, and nearly 40 times the power available in the Valley in 1933. It seems unlikely that even a system of the capacity that will be reached in 1956 will meet the Valley needs for power for a long period.

Up to the present, the TVA power system has been primarily hydro-electric, supplemented by steam to meet the low-water season of the year. We are now in a transition period. A few more dams may be built in the river system, but the time has passed when this would meet the power demands of the region. From now on, additions to the power production facilities will be mostly steam-electric plants. In fact, the construction program now in progress will result in production of much more than half the total power from steam plants.

The new power added to the system by steam plants will cost more than the hyrdoelectric power from existing hydro

plants. This developing situation led the TVA Board in the past year to reconsider its whole power rate schedule, and out of this has come another of the important policy-making decisions that have shaped the TVA. This decision rests on the belief that the cheaper hydroelectric power from the river should be dedicated to the service of the small domestic consumers of the Valley, and that industry should bear most of the effects of adding the more expensive steam power. The situation is a very complex one, for the low rates that domestic consumers enjoy in the Valley would not be possible without some steam-electric power, and would not be possible without some of the large, high-use-factor loads that big industries furnish. But the intent of the new rate schedules is to protect the small consumer as far as is possible. The higher rates that industries must pay will still be attractive rates because of the economies possible in such a large and flexible system as the TVA's.

The impact of this industrial development of the Valley on the people and institutions of the region will be marked. As noted earlier, the income per capita in the Valley was only 42 percent of the national average in 1933. Today it stands at 56 percent of the national average although the per capita income of the nation has increased meanwhile. But there is still a long way to go. One of the major economic difficulties of the region stems from the fact that there are too many folks in the Valley trying to make a living out of agriculture. Industries will not only draw away this surplus of unprofitable farm labor, but will increase both the wealth of the Valley and the income per capita. They will also offer opportunities for young men and women of the South who are trained in our educational institutions to find careers here instead of facing the necessity of leaving the South to find professional opportunities.

Industrialization will not be entirely a blessing—it never is. But some of the evils can be avoided if plans are made and put into effect in time, plans which will enable the people of the area to cope with the social, economic, and environmental problems that accompany industrial expansion.

The crystal ball, then, reveals a continued expansion of the power facilities of the region, mostly from steam plants, and continued industrial development. It seems probable that the effect of industrialization of the Valley will bring about a greater change in the economic and social environment than any other single influence now visible in the picture.

Agriculture in the Valley

There has been a considerable change in the agricultural situation in the Valley since 1933 and certain trends are evident that will probably continue for some time to come. The major over-all changes have been the following:

(a) A large decrease in the farm population; in the period 1934 to 1944 this decrease amounted to 23.8 percent.

(b) The number of farms operated has decreased and there has been a large decrease in the number of tenant farmers.

(c) The acreage devoted to row crops has decreased sharply, while that devoted to small grains, hay, and pasture has increased.

(d) The use of fertilizers and lime has increased about 1000 percent.

(e) Improved pastures, using fertilizers and better varieties of clovers and grasses, are increasing at a lively clip. With this has come an increase in numbers of beef and dairy cattle.

(f) The farm home has changed greatly. In 1933 only about 3 percent of farm homes were served with electricity. Today more than 80 percent have electric service. This change has brought not only electric lights, but also refrigerators, radios, electric ranges, dishwashers, vacuum cleaners and the like to the farm houses, along with running water

in the houses and barnyards, lights and hay driers in the barns, milking machines and milk coolers in the dairies.

(g) Mechanization of farming has taken place rapidly. Tractors and trucks have largely replaced horses and mules on the farm.

The changes listed above have been striking, but agriculture in the Valley still has a long way to go if it is ever to become permanently profitable. In general, the soils of the Southeast are of relatively low fertility and high crop yields depend on liberal application of fertilizers. Farm units are too small. There is still far too large a proportion of scrub breeds in beef and dairy herds, and too many incompetent farmers. Excessive soil erosion is still a serious problem. As against these handicaps, agriculture here in the Southeast has the advantages of a long growing season, a great variety of soils, generally favorable distribution of rain, and a mild climate. These favorable factors must be utilized fully if the handicaps are to be offset.

Industrialization of the Valley will, no doubt, affect agriculture profoundly. In the period 1929-1950, income from manufacturing increased from 15 percent of the total to 20 percent, while income from agriculture decreased from 23 percent of the total to 12 percent. The number of farms and farmers will continue to decrease, lands ill-suited to agriculture will no longer be used for crop production, part-time farming will increase. There may come the opportunity to increase the size of farm units.

The agricultural colleges, the TVA, and the other local and federal agencies have done much to improve agriculture in the Valley since 1933. The far flung farm test-demonstration program has proved to be an effective one in farmer education. The fertilizers produced by the TVA at Wilson Dam have played an important role in the educational process and have been used to induce farmers to adopt better farm operation.

Looking to the future, it appears that agriculture in the Valley is in the early stages of a rather far-reaching transition. The coming of industry into the Valley will lessen the urge to till the poorer classes of land, and this raises the problem of how best to utilize such land. Part-time farming will increase in the Valley, and there will be hundreds of cases where one or more members of a farm family will be employed elsewhere than on the farm although continuing to live in the farm home. The growth in population of the Valley has been for some decades limited to the towns and villages. This tendency will continue, but with modern means of transportation and good roads we may expect a wider spacing of dwellings around the trade centers.

Forestry in the Valley

About 54 percent of the Valley area or some 14 million acreas are in forests and farm woodlands. Any change in the ratio of wooded to nonwooded areas will necessarily come slowly because of the magnitude of the areas involved. Foresters estimate, however, that the current yield of income from forests in the Valley is less than one-third of the potential yield. Much progress has been made since 1933 in extending fire protection, in improvement of forest management, and in afforestation of lands not suited to agriculture.

It is a bit surprising that in a region naturally suited to timber production so little has been done until recently to take advantage of this natural resource. In 1933, completely adequate fire control in the forested land was at almost the zero level, about 10 percent of the area had fair control, about 40 percent had meager

control, and 50 percent had no control. Today the picture is considerably better. Fully adequate control has risen from almost nothing to about 40 percent, and near adequate control adds another 25 percent, and partial control adds about 10 percent. About 25 percent of the forests have, as yet, little or no fire control. Fire protection of privately-owned forests in the Valley is primarily the responsibility of the state agencies, with some federal aid. Eighty-two of the 125 counties in the Valley now have county-wide forest fire protection. It will be noted, however, that about 25 percent of the Valley forests are not yet protected from loss by fire.

Good forest management is expanding slowly in the Valley, with consequent progress toward increased and sustained income yields. There are some fairly large consolidated holdings of timber lands in the Valley. The East Tennessee Iron and Coal Company holds some 53,400 acres, and the Virginia Iron, Coal and Coke Company another 18,000 acres. Both these concerns are now moving toward good management of their forests. The larger lumber companies are doing likewise. Last year the Hassell and Hughes Lumber Company in Wayne County, Tennessee took 68 percent of their total cut in hardwoods, whereas only seven years ago this company was actively cutting itself out of business by stripping the pine from its 75,000 acres. Municipally-owned forest lands are now becoming sources of sustained income with no diminution of the recreational value of the forested lands. I note that Kingsport's 1200-acre forest has netted the city about $34,000 from timber sales since 1948. Waynesville, North Carolina has realized a net of about $63,000 from timber sales since 1949. State forests, such as Tennessee's Natchez Trace Forest, are likewise becoming sources of steady income under improved management.

The opportunity for sound private investment in forest lands is still open. As one instance, in 1944 a private investor bought 17,466 acres of coal and timber land on which taxes were delinquent. Today strip-mined coal is more than paying for the total cost of developing the property; and the interesting thing is that, by the time the coal deposits are worked out, the value of the property will be greater than it was in 1944 because by that time it will be on a sustained income basis through sale of saw timber from a well-managed forest.

Almost every farm in the Valley has a woodlot. Only recently have farmers, and not as yet many of them, become aware of the potential value of these lands as sources of increased farm income.

The trends in forestry that are evident in the Valley are the net results of an intensive educational program in which the state and county organizations, the colleges, private companies, and the TVA have cooperated. Sawmill schools, farm woodland management demonstrations, harvesting demonstrations, fence post treatment demonstrations, and many other educational programs are now organized throughout the Valley.

Looking to the future it seems reasonable to expect increased utilization of forests as sources of sustained income, and, as in the case of the river system, another of the great natural assets of the Valley used as it should be. A large pulp and paper mill is now under construction near Charleston, Tennessee. This development is particularly desirable because the company must rely on the timber resources of the Valley and must so manage its forest land that a continued yield of wood will be forthcoming. In the long run it must grow trees as fast as it uses them. That is the

ideal situation for the forested area of the Valley—a high rate of use matched by an equally high rate of renewal of the resource.

Recreational Facilities in the Valley

The Tennessee Valley is fast becoming one of the playgrounds of the Nation. During the summer about a million visitors a month visit the TVA dams. There are now about 600,000 acreas of open water in TVA reservoirs that have a shoreline of about 10,000 miles. Recreational developments, facilities, and services along the lakes are now valued at $31.8 million. There are 12 state parks, 18 county parks, and 22 municipal parks adjacent to TVA reservoirs. There are also 29 group camps and over 1300 acres in private club sites. There are thousands of privately-owned cabins on the reservoir shores and thousands of pleasure craft on the lakes.

As yet no great portion of the 10,000 miles of shoreline is occupied, and the boats on the lakes seem lost in the great expanse of water. There are still more fish than fisherman. The combination of attractive lake shores, of mountain scenery, and of good roads is bound to bring an increasing number of visitors to the area. The tourist trade of the Valley will certainly continue to flourish, and yet, so big is the out-of-doors that local folks can still get away from crowds when they wish to do so.

The Long Pull

In 1889, Henry W. Grady, then editor of the *Atlanta Constitution*, had this to say of the funeral of a "one-gallus" resident of Pickens County, Georgia:

"They cut through solid marble to make his grave, and yet a little tombstone they put above him was from Vermont. They buried him in the heart of a pine forest, and yet the pine coffin was imported from Cincinnati. They buried him by the side of the best sheep-grazing country in the world, and yet the wool in the coffin bands and the coffin bands themselves were brought from the North. They buried him in a New York coat and a Boston pair of shoes and a pair of breeches from Ch'cago and a shirt from Cincinnati. The South didn't furnish a thing on earth for that funeral but the corpse and the hole in the ground."

Grady thus used the occasion of a simple funeral to point out some of the reasons for the South's poor economic status. He did not know how slowly this situation would change. Only now, sixty odd years later, is the pace of industrial development rapid and the region now faces all the problems of adjustment that normally come therewith. Events now in the making will certainly create an environment greatly different from that of the past. The wealth of the South and the per capita income will surely increase. This area will henceforth contribute more than it has in the past to the federal income; likewise the states and counties and towns of the area will be able to undertake improvements that were not before possible. It should be possible to have better schools, better hospitals, better farms, cleaner towns, more comfortable homes, better health. These things can come, not because there happens to be an active federal agency in this region, but because mobilization of the natural resources that lie in falling water and growing forests, in farm lands, in mineral deposits, in climate and scenery will bring the wealth and income that put better things within reach. They will be within reach, but whether they are captured will depend not on the TVA but upon how well the people of the area meet the challenges of the new situation and seize the opportunities offered.

The TVA has played a role since 1933 and will continue to be a factor in the

situation, but the destiny of the area does not lie in TVA hands. The TVA, in broad terms, is an experiment; it is testing the possibility of bringing timely federal aid to an economically-undeveloped area without encroachment on the local state, county, and municipal freedom and initiative. The success of the experiment will be gauged in the long run by the degree to which the local agencies of the people avail themselves of the facilities provided by TVA so that they may better perform their normal functions, and by the degree to which the TVA can increase the freedom of people to determine their own future.

Urban Size: An Assessment

By ROBERT M. LILLIBRIDGE*

WITH recognition of the various urban area functions is coming an awareness that size of the urban area definitely relates to the function and the social relationships thus served.[1] The following discussion summarizes the available research on measurable criteria of urban size and function relationships and makes note of areas for further research to eventually enable urban size studies to provide the base for soundly-conceived city plans.

The question of urban size relates to numerous problems of urban development. In this era of technological advance, complete and integral new communities can be constructed in a relatively brief period of time. Practical application of findings can be made in development of these new cities.

Ebenezer Howard developed the contemporary thesis of new city size control in relation to development of new cities.[2] Exponents of Howard's ideas have amplified his ideas further.[3] Recent impetus to the idea of controlled urban size has been given by the New Towns program in Great Britain.[4]

In America, development of the Greenbelt towns, and more recently of Leavittown, New York; Park Forest, Illinois; Oak Ridge, Tenn.;[5] and the numerous new or proposed new industrial towns provide impetus to investigations in this field.

Another major application of urban size findings relates to the extension and redevelopment of existing cities.[6] British recognition of such application of findings is evident in the Greater London Plan of 1944[7] and other planning studies.[8] The city planning profession in America has recognized the problem of size limitation involved in neighborhood and community planning.[9] In extension of American urban areas, increasing recognition is being given to the problem of total size limitation. However, due probably to general inability to exert positive controls and to the lack of available data, recommendations have not usually been made and such recommendations are not generally included in city plan studies as a basis for redevelopment proposals.[10]

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[1] One of the most recent investigations based on these relationships deals with airport planning: U. S. Dept. of Commerce, Civil Aeronautics Administration, *Economic Character of Communities* (Washington: D. C., the author, November 1948) processed.

[2] Ebenezer Howard, *Garden Cities of Tomorrow* (London: Faber and Faber, 1946).

[3] Raymond Unwin, "The Town and the Best Size for a Good Social Life," In *Town Theory and Practice*, edited by C. B. Purdom (London: Benn Brothers, 1921). F. J. Osborn, *Transport, Town Development and Territorial Planning of Industry*, No. 20, The New Fabian Research Bureau (London: Victor Gollancz, 1934). F. J. Osborn, *Greenbelt Cities* (London: Faber and Faber, 1946).

[4] Great Britain, Ministry of Town and Country Planning, *Final Report of the New Towns Committee* (London: H.M.S.O., 1946) F. J. Osborn, "New Towns in Britain," *Journal of the American Institute of Planners*, Winter 1947, pp. 4-10. Michael Rosenauer, "Britain Builds Her New Towns," *Architectural Record*, December 1950, pp. 100-105.

[5] Skidmore, Owings and Merrill, *Report to the Atomic Energy Commission on the Master Plan, Oak Ridge, Tenn.* (Chicago: the author, December 1948).

[6] Russell Van Nest Black, *Planning for the Small American Community* (Chicago: Public Administration Service, 1944) p. 24. Robert R. McIntosh, "Measurement for Size," *Public Works Engineering News Letter*, June 1950, p. 6.

[7] Patrick Abercrombie, *Greater London Plan, 1944* (London: H.M.S.O., 1945).

[8] Thomas Sharp, *Town Planning* (Harmondsworth, Middlesex: Penguin Books, 1945) pp. 54-57.

[9] American Public Health Association, Committee on the Hygiene of Housing, *Planning the Neighborhood* (Chicago: Public Administration Service, 1948).

[10] Harland Bartholomew, "The Present and Ultimate Effect of Decentralization on American Cities," *Real Estate Record*, October 12, 1940, pp. 5-8. Russell Van Nest Black, *op. cit.* Lewis Mumford, *Culture of Cities* (New York: Harcourt Brace, 1938) pp. 487-488. Lewis Mumford, "Regional Planning and the Small Town," *Journal of the American Institute of Architects*, August 1950, pp. 82-91. Jose Luis Sert, "The Human Scale in City Planning," in *New Architecture and City Planning*, edited by Paul Zucker (New York: Philosophical Library, 1944) p. 396. Jaqueline Tyrwhitt, "The Size and Spacing of Urban Communities," *Journal of the American Institute of Planners*, Summer 1949, p. 10-17.

The third major field for application of findings relates to decentralization, which in some respects is a facet of the problem of urban extension. Decentralization of population from the central city to satellite portions of metropolitan districts has been advocated by many students of urbanism.[11] Decentralization has also been advocated to implement civilian and military defense,[12] and to provide safer location of industrial establishments.[13]

Despite the possibility of these important applications of urban size investigations, to date—as the following analysis reveals—there is a scarcity of fact upon which to base urban-size limitations, let alone to suggest satisfactory forms which this growth might take.

Criteria Analysis

Analysis of the desirable relationships to be served in an urban area sometimes proceeds as a search for a general "optimum size." An optimum size for a given urban area with specific functional and locational factors may be attainable but the quest for a general optimum is unrealistic.

With the industrial revolution and the consequent rapid evolution in urban pattern, a complex urban structure has been in process of formation. It may consist of isolated hamlets, villages, and independent cities, or metropolitan districts with central city, satellite urban and rural and hinterland sections.[14] Differentiation of function characterizes this urban pattern. These various urban forms may serve a single function, or as is the case with most cities, they may be multi-functional. The function may include commercial, industrial, extractive, political, recreational or educational activities.[15] Thus, the function of a specific city involves not only the social and economic relationships within the city, but the relation of the city to the remainder of the urban pattern.

Although some studies pertaining to urban size may thus have proceeded without full regard for the emergence of new urban patterns, or have had inadequate data as a base, a review of all findings proves of great value. Such a review will reveal the range of research accomplished including population base for specific criteria, the variety of methodology used; and will indicate research required.

The literature of city planning is replete with assumption and broad general statements concerning criteria. The very heterogeneous nature of these criteria and the lack of correlation with functional characteristics illustrates the unformed and unexplored character of this field of investigation. Occasionally, definite criteria are listed. Unwin, in 1921, probably listed as comprehensive a group of criteria as can be found in the literature.[16]

In the recent thorough analysis of criteria which Duncan undertook, criteria

[11] Representative sources for the various approaches follow: Radhakamel Mukerjee, *Social Ecology* (London: Longmans, n.d.) p. 283. William Fielding Ogburn, "Sociology and the Atom," *American Journal of Sociology*, Jan. 1946, p. 267-275. Paul Windels, "How Should Our Cities Grow?" *Journal of the Ameerican Institute of Architects*, October 1950, pp. 148-153 and November 1950, pp. 223-227.

[12] Warren J. Thompson, "The Atomic Threat," *Cities Are Abnormal*, edited by Elmer T. Peterson (Norman: Univ. of Oklahoma Press, 1946). Tracy B. Augur, "The Dispersal of Cities as a Defense Measure," *Bulletin of the Atomic Scientists*, May 1948, pp. 131-134.

[13] Great Britain, Royal Commission on the Distribution of the Industrial Population, *Report* (London: H.M.S.O., January 1940).

[14] Don J. Bogue, *The Structure of the Metropolitan Community: A Study of Dominance and Subdominance* (Ann Arbor: University of Michigan, 1949). Robert E. Dickinson, *City Region and Regionalism* (London: Kegan Paul, 1947) pp. 45-51. Amos H. Hawley, *Human Ecology* (New York: Ronald Press, 1950).

[15] Chauncey Harris, "A Functional Classification of Cities in the United States," *Geographical Review*, January 1943, pp. 86-99. Grace Kneedler Ohlson, *Economic Classification of Cities* (The Municipal Yearbook, Chicago: The International City Managers' Association, 1950) pp. 29-37.

[16] Raymond Unwin, *op. cit.*

were listed under eleven categories.[17] That arrangement was made solely for reasons of convenience and not from any precedence or weight one heading had over another. In the following discussion the various categories and criteria referred to in the literature and summarized by Duncan, are given with summary of significant research.

(1) *Physical Layout.* The major emphasis in this category relates to the journey-to-work.[18] One British publication notes the necessity for a town of sufficient size to provide a balanced variety of employment and sufficient scope for talents of the inhabitants, but not so large as to involve its residents in travel of half-an-hour or more by train, bus, or cycle to reach their work or the open country.[19]

Branch has investigated public opinion regarding the journey-to-work and to other facilities.[20] That survey indicated that the large-city resident takes about two-and-one-half times as long to get to work as does the small-city resident. With the extreme mobility of the great majority of the American people, urban size limitation to allow for a reasonable journey-to-work, is difficult to determine. It is probably accurate to state that American cities, as far as area is concerned, should be of such size or so located within the urban pattern, that the journey-to-work is not unduly tiresome or costly in time, money, or effort.[21] What that point is, will have to be determined by future research.

Another criterion suggests access to the open country. Osborn suggests a city of 50,000 persons, at 25 persons per acre, will have a one-mile radius.[22] A one-mile radius, supposedly, would allow ready access to open areas, greenbelt, or locations of employment. Duncan cites Stewart's formula as indicating a much greater radius for American cities of 50,000 persons.[23] The one-mile radius is found in American cities at the 10,000 population mark. American cities of 50,000 population average about one and three-quarters miles in radius. The American emphasis on single-family detached structures accounts for this. The increased mobility of Americans, even with the increase in radius, might still allow ready access to open country, but data are not available to validate this view.

The city sizes which necessitate use of the various types of mass transportation are also of interest. The greater the dependence upon such transportation ofttimes the more strenuous are conditions for workers. Duncan's analysis indicates that with a population of 10,000 to 15,000 persons, some form of mass transportation becomes feasible or necessary. A town population of around 50,000 makes street cars economically justifiable, although current technological develop-

[17] The most thorough treatment of the urban-size problem to which this author is, and future investigators undoubtedly will be greatly indebted is the following: Otis Dudley Duncan, *An Examination of the Problem of Optimum City-Size* (Ph.D. dissertation in the Dept. of Sociology, University of Chicago: March 1949). This dissertation is available on microfilm from the University of Chicago Library. Abstracts are given in: Otis Dudley Duncan, "Optimum Size of Cities," in *Reader in Urban Sociology*, edited by Paul Hatt and Albert Reiss (Glencoe, Ill.: Free Press, 1951) pp. 632-645 and James Dahir, "What Is the Best Size for a City," *American City*, August 1951, pp. 104-105.

[18] Jean Thompson, "The Journey to Work: Some Social Implications," *Town and Country Planning*, November 1950, pp. 441-446.

[19] National Council of Social Science, *The Size and Social Structure of a Town* (London: Allen and Unwin, 1943).

[20] Melville J. Branch, *Urban Planning and Public Opinion* (Princeton, N. J.: Princeton Univ. Bureau of Urban Research, 1942).

[21] More extended discussion of these points is given in: American Society of Planning Officials, *The Journey to Work. Relation Between Employment and Residence*, Planning Advisory Service, Information Report No. 26 (Chicago: the author, May 1951). J. Douglas Carroll, Jr., "Some Aspects of Home-work Relationships of Industrial Workers," *Land Economics*, November 1949, pp. 414-422. Kate K. Liepmann, *Journey to Work* (New York: Oxford Univ. Press, 1944).

[22] F. J. Osborn, *Transport, Town Development . . ., op. cit.*, p. 19.

[23] Otis D. Duncan, *op. cit.*, pp. 56-63, physical layout discussion.

ments and the competition of other forms of transportation are probably causing that population figure to increase. It would be desirable to indicate more definitely at which point mass transportation ceases to become merely a convenience and becomes a necessity.

The use of the private automobile does not diminish appreciably in American cities of moderate size, despite the feasibility of reaching the employment location by other means. In analysis of 22 representative American cities, Duncan found that in the seven cities between 25,000 and 100,000 there was a median of 81 percent who arrived in private automobiles; in the six cities of 100,000 to 500,000 population, the median percent was 72; and for nine cities over 500,000, the median was 41 percent. In very large cities the central business district becomes more difficult of penetration. Despite this fact, the number of private automobiles travelling to and from central business districts is increasing beyond all expectations.

In physical layout analysis, the journey-to-work and access to open country are both dependent upon transportation. Study is needed to reveal the full relationships involved in mass transportation and use of private vehicles as they affect the urban function. Local conditions and technological advances may make such determinations highly variable.

(2) *Economic Base.* In city planning literature, it is generally stated that diversity of the economic base will allow workers more choice in employment, and if difficulties beset one class of industry, the entire city will not immediately be affected. Also, it sometimes is assumed that cultural life may be stimulated by diversity of the economic base.

McLaughlin attempted to measure diversity of very large cities, but data for smaller cities are of sufficient accuracy for only the roughest analysis.[24]

Duncan took a sample of cities over 10,000 population in the East North Central geographic division for measurement of industrial diversity. That analysis indicated a rise in the number of industrial groups with increase in city-size, but it must be noted that, even with the 10.2 industrial groups found in the smaller size group, 10,000-25,000, a considerable degree of industrial diversity may be present.[25]

The effect of industrial diversity in mitigating the effects of economic depressions and fluctuation in the local business cycle, has been explored in a cursory manner. Samuelson, in a study involving the 50 largest U. S. cities and 31 "intermediate size" cities in Massachusetts, reported that there appears to be no significant positive relationship between town-size and intensity of unemployment.[26] The direct implications of urban-size on diversity of the economic base and fluctuations of the economic cycle thus are not absolutely positive.

A more fundamental approach to the question of the population requirements necessary for a stable economic base has been made by Clark.[27] In his study, the United States, Great Britain, Canada, and Queensland were analyzed to determine what size of city is necessary for the efficient performance of the functions which a modern community require. In that study, service industries rather than manufacturing industries were determined to be the key factor.

[24] Glenn E. McLaughlin, "Industrial Diversification in American Cities," *Quarterly Journal of Economics*, November 1932, pp. 131-149.

[25] Otis D. Duncan, *op. cit.*, pp. 64-68, diversity of economic base discussion.

[26] Paul Samuelson, "The Business Cycle and Urban Development," *The Problem of the Cities and Towns*, Report of the Conference on Urbanism, edited by Guy Greer, Harvard Univ., March 5-6, 1942, p. 6-17.

[27] Colin Clark, "The Economic Functions of a City in Relation to Its Size," *Econometrica*, April 1945, pp. 97-113.

Clark concluded that a region can give its inhabitants an adequate range of commercial services when the population of the principal city is somewhere between 100,000 and 200,000 persons. In the case of service industries, a smaller population would generally suffice. In new manufacturing centers, it was noted that a population between 200,000 and 500,000 seemed adequate for full development of manufacture. Clark's conclusion, due to his unorthodox conception of regions for the United States, will need further substantiation, but his approach represents an advance in conception of the problem.

A recent report by the National Industrial Conference Board indicates that many industries in the United States, between the years 1940-1947, preferred to locate in cities between 10,000 and 100,000.[28] According to that report, of the 148 major manufacturing companies surveyed, almost 30 percent of the plants established in those years were in towns of 10,000 or less, and only one-third of the plants built or acquired in those years were in cities of 100,000 and over. For plants established prior to 1940, close to half the plants were in cities of 100,000 and over, and 20 percent of the plants were in cities of 10,000 or less. This indicates a distinct trend to cities of moderate size, although only 28 percent of the plants were following a deliberate decentralization policy.

The various aspects of economic base study for worker and employer choice and for the establishing of a stable regional base need much further investigation.

(3) *Health.* In considering the health of urban residents, two types of criteria are involved.[29] The first involves analysis of facilities for treatment of disease, and the second, risk of ill-health which the resident may incur.

The number of physicians in a given urban area directly affects service available. Duncan found that cities of 500,000 to 1,000,000 have 75 to 100 percent more physicians in relation to population than cities of 2,500-5,000. Specialists also increased until the 1,000,000 point was reached, where the ratio fell significantly. The population base for adequate specialist service, from British experience, has been estimated to be between 250,000 and 300,000, without necessitating extensive travel.[30]

In hospital survey, Duncan found that 95 percent of the cities above 10,000 have a general hospital, whereas only 75 percent of the non-metropolitan cities of 5,000-10,000 have hospitals, and less than 50 percent of the cities from 2,500 to 5,000.

Survey of infant mortality, maternal mortality, and general mortality, according to Duncan, indicate that the first two are correlated inversely with city-size with cities of 100,000 and over, having consistently the lower rates.

Life Table Analysis indicates that in the first year of life the mortality rate is inversely related to city-size. This advantage of the larger cities is maintained through early adulthood, but is surrendered to the smaller and middle sized cities in the later years of life. This fact is compatible with the hypothesis stated by Duncan, that the disadvantage of the large city begins to appear in connection with long-term environmental effects, whereas it has an actual advantage in the ability to save lives where immediate medical care is critical.

[28] National Industrial Conference Board, Inc., *Decentralization in Industry* (New York: the author, 1948).

[29] Otis D. Duncan, *op. cit.*, pp. 69-109, health discussion.

[30] A. H. T. Robb-Smith, "Planning Without a Plan," *The Lancet*, August 28, 1943, pp. 243-249. See also: K. S. Lomax, "The Relation Between Expenditure per Head and Size of Population of County Boroughs in England and Wales," *Journal of the Royal Statistical Society*, Vol. 106, Part I, 1943, pp. 51-59.

(4) *Public Safety.* It has been repeatedly noted that urban crime rates are higher than rural. However, Duncan noted that the relation is not the same for all types of crime, and that there are considerable variations in the consistency of the association of city-size and incidence of crime.[31] He concluded cities under 50,000 tend to have a relatively low incidence of crime.

Law enforcement cost analysis indicated that the larger cities spend proportionately 3 or 4 times as much per capita as the smallest cities. Further work is required to denote the city-size group which may have an advantage in per capita law enforcement cost complementary to a low crime rate.

Analysis of mortality from motor vehicle accidents, on the basis of cases per number of registered vehicles, indicated that cities of 25,000-50,000 are safer than cities of any other size.

Property damage from fires is more severe in large cities than in small cities. This is caused by the high property values in large cities, since small cities have a greater proportion of fires than do large cities. The largest fire departments, in relation to population, are found in cities between 50,000-250,000.

Angur and other writers state that safety from atomic bombs can, in some degree, be achieved by limiting urban-size to 50,000. The theory recognizes that the smaller target has fewer chances of being hit. There are no measurements which allow analysis of this hypothesis.

(5) *Municipal Efficiency.* The fundamental issue in study of urban-size, according to numerous writers, is to achieve an economical municipal operation. Probably municipal efficiency is of ranking importance after consideration of the economic base, as Stein has suggested in his review of community development in America.[32]

British analysis of existing cities has been made over a period of years with varying results as to urban size—municipal efficiency relationships. Baker, in 1910, analyzed expenditures for a group of 72 English cities.[33] For those cities ranging from 25,000 to 750,000, he noted a tendency for the lowest per capita expenditures to occur near the 90,000 figure. For such services as gas and electricity, however, Baker stated that increasing population resulted in lower unit costs. For the remainder of services, increasing population meant higher costs per unit. Study of 1912-13 municipal statistics for British cities confirmed Baker's findings to some extent.[34] It concluded further that the per capita cost in cities of 250,000 and over considerably exceeded per capita costs in cities under that figure.

In the Oxford report, a survey was mentioned which suggested that cities between 100,000 and 200,000 are cheapest to govern, and that at both extremes—in the mammoth cities and in those of 70,000 and less—local government was considered disproportionately costly.[35] Substantiating data is needed to verify these conclusions. Recent analysis by Phillips, however, does support the Oxford conclusion.[36] Phillips' analysis of nine types of municipal expenditures indicated that groups of cities averaging

[31] Otis D. Duncan, *op. cit.*, pp. 110-133, public safety discussion.

[32] Clarence Stein, *Toward New Towns for America* (Liverpool: England, University Press of Liverpool, 1951) p. 104.

[33] C. Ashmore Baker, "Population and Costs in Relation to City Management," *Journal of the Royal Statistical Society*, Dec. 1910, pp. 73-79.

[34] London County Council, Local Government and Statistical Department, *Comparative Municipal Statistics 1912-13* (London: the author, 1915).

[35] Oxford University, Barnett House Survey Committee. *A Survey of the Social Services in the Oxford District, Volume I, Economics and Government of a Changing Area* (London: Oxford University Press, 1938).

[36] Hugh S. Phillips, "Municipal Efficiency and Town Size," *Journal of the Town Planning Institute*, May-June 1942. pp. 139-148.

108,000 and 124,000 have low per capita costs. He further concluded it is probable that somewhere between 100,000 and 250,000, municipal efficiency will have an optimum technical position.

Davenport, in probably the earliest American recognition of the problem, analyzed expenditures for New York municipalities.[37] In that study of 1920 data, it was found that villages below 500 had high per capita costs; cities between 1500-2000 had lowest costs; cities between 2000-15,000 had practically the same costs, but for cities above 15,000 the tendency was for costs to increase both in relative and absolute amounts with increase in city-size.

The U. S. Bureau of the Census' municipal finance data for the years 1940, 1942, and 1943 were analyzed by this writer. From analysis of total operation payments for that limited group of years, it is apparent that there was a significant lowering and levelling of per capital costs in the city-size groups ranging from 199,999 to 275,000. From that level, costs rose abruptly to those of the 600,000-799,999 group. Despite the lowering of per capita costs for the 199,999-275,000 city-size group, the cities below 25,000 had even lower per capita total operation payment costs. Duncan analyzed similar data for 1942 by the 14 categories of expenditures with varying results indicating, in general, a constant rise in per capita costs with increase in city-size.[38] A study of 1931 data also indicated a similar constant rise in per capita costs.[39] More detailed analysis of such data is needed to reveal the cause for this divergence in results and the comparative relationships in expenditures.

In both British and American analysis, it appears that an optimum size range may extend somewhere between the 100,000 and 300,000 population figures. Critical observation of the data, breakdown of cities by smaller size groups for more ready detection of critical points and analysis of data for a continuing period of years, may assist in further refinement of conclusions.

The difficulties in statistical comparison of city data are readily apparent. Frequently, costs are not separated by distinct categories of expenditure and variable factors including costs, amounts, and quality of services are involved. In part, it may be that increasing expenditures reflect increasing amounts and quality of services. The difficulties involved in attempting to rate degree of efficiency are indicated in Walker's study.[40] In that study only slight advantages for the 30,000-300,000 city-size group over other size-groups were noted. That study also emphasizes the need for more accurate measurement of municipal operations efficiency.

In contrast to the foregoing results favoring cities of moderate size, are the results of Duncan's residential electric service study, which verifies Baker's findings.[41] Such service is usually rendered on a community basis. Duncan's study showed a rather definite optimum at the 500,000-1,000,000 size group, and in cities up to 1,000,000, per unit costs steadily decreased. It may be inferred from this analysis that, for types of service where initial installation involves high unit costs, increasing size of the plant may assist in lowering unit costs.

In contrast to the extensive type of research related to municipal efficiency,

[37] Donald A. Davenport, "An Analysis of the Cost of Municipal and State Government and the Relation of Population to the Cost of Government, Income and Land Values in New York State," *Report of Commission of Housing and Regional Planning* (Albany, State of New York: January 11, 1926).

[38] Otis D. Duncan, *op. cit.*, p. 137-140.

[39] National Resources Committee, *Urban Government* (Washington: G. P. O., 1939), p. 33.

[40] Mabel L. Walker, *Municipal Expenditures* (Baltimore: Johns Hopkins Press, 1930).

[41] Otis D. Duncan, *op. cit.*, p. 140-141.

are the intensive studies of specific cities. The report prepared by Stein preparatory to construction of the Resettlement Administration towns, presents the basic approach for such analysis.[42] This report, prepared in 1935, showed consistent decrease in total annual cost per person for towns ranging in size from 3,000 to 7,000 persons. Annual cost per person ranged from $52.34 in a town of 3,000 persons to $41.86 in a town of 7,000 persons.

A more recent study for Greendale, Wisconsin, one of the Resettlement Administration towns, also involved cost estimates for municipal operation.[43] Costs were prepared for the town to expand from 635 families, by 200 family intervals, to a maximum of 4,000 families. It was found that, for Greendale, the optimum size was about 3,500 families, although the per family costs at the 6,000 family level were almost equal to those at the 3,500 family level.

Such intensive study of municipal data under controllable conditions may offer better opportunities for appraising relationships than are obtainable through extensive analysis of a mass of data. The experience with new towns, both in England and America, may provide a key opportunity for extension of our knowledge in this regard.

(6) *Education and Communications.* Expenditures for education as analyzed by Duncan, indicated that, in general, the large city of over 100,000 was able to mobilize more monies for child education than was the small city.[44]

A wide variety of other criteria were analyzed by Duncan. That analysis indicated that less than 20 percent of the cities below 250,000 have all 12 types of professional schools. For professional schools, museums, and libraries, it was found that a city of about 50,000 was required. However, intensity of museum and library use varied inversely with size. Probably due to mobility of the American people, it was found that educational status, in terms of years of education, does not vary significantly from one city-size group to another. Means of communication including radio and newspapers, appear to require a population of about 25,000. However, television, partly as a result of its recent introduction to the public, is largely confined to cities over 500,000.

(7) *Recreation.* Park data available, unfortunately, are not readily comparable and useable, although they are abundant. In terms of acreage, as analyzed by Duncan, the data clearly show that proportionately more cities of 50,000-250,000 have adequate park systems than cities of any other size.[45]

As far as park accessibility is concerned Duncan noted that cities over 1,000,000 have but one park for every 10,000 inhabitants whereas, in a city of 10,000, the inhabitants have 5 parks available. There evidently is a tendency for park facilities to be more readily accessible to the population in smaller cities. The accessibility of open land on the periphery of small cities, where unorganized recreation is readily possible, also gives the smaller cities an advantage.

Analysis of the presence of zoos, symphony orchestras, opera, and motion picture theaters by Duncan, indicates that the first three are present mainly in large cities. Zoos were present in all

[42] Clarence S. Stein, *Studies of Operation Maintenance Costs In Suburban Resettlement Administration*, Dec. 5, 1935. Manuscript available at the Joint Reference Library, Chicago. These studies are referred to in: Clarence S. Stein, *op. cit.*, pp. 148-149 and 208-209.

[43] Walter E. Kroening, *The Planning and Management of Greendale, a Greenbelt Suburban Community.* A paper presented at the Chicago Conference of the National Association of Housing Officials, April 4, 1948, mimeo.

[44] Otis D. Duncan, *op. cit.*, pp. 142-177, education and communication discussion.

[45] Otis D. Duncan, *ibid.*, pp. 178-197, recreation discussion.

cities over 500,000, and in 76 percent of the cities 250,000-500,000. For symphony orchestras, it may be concluded that 50,000 is, in general, the minimum population base, and that 100,000 is the base for an orchestra of truly symphonic size. Opera is a scarce item and is found in only 3 or 4 cities over 500,000. Movie theaters are well distributed in American cities of all sizes. The population base in towns in the 2,500-5,000 size class is 2,400 and in towns of 1,000,000, 10,000.

(8) *Retail Facilities.* A population base sufficient for a variety of adequate shopping facilities is one of the prime factors in city development. The population base required for various retail facilities varies considerably.[46] Schettler, in study of 101 midwestern cities ranging in size from 2,600 to 80,700, noted that the lower ratios of persons per single economic service are usually found in cities of 2,500 to 5,000, and that the largest ratios are found in cities of 25,000 to 35,000.[47] Duncan noted a wide population base variation for facilities in minimum size cities and cities in the 500,000-1,000,000 size range.[48]

As to kinds of stores, Duncan observed that a city of 2,500-5,000 can be expected to have at least one kind of store in each of the 15 major categories of business. As observation bears out, greater specialization occurs and more kinds from each category are present in the larger cities. General observation of the population base required for the various types of retail facilities suggests that 50,000 is about the minimum to give the entire range of 65 retail types mentioned in the U. S. Census data.

The kinds of stores, together with variety available in those stores, are related to urban size. Pfanner, in study of jewelry, silverware, and clocks, and women's apparel, concluded that there was no significant difference in the drawing power of cities over 100,000 by size of city.[49] However, he concluded that, in furniture, cities below and above 100,000 have equal drawing power. If similar findings obtain for other types of purchases, and these findings are verified, the optimum size of a city from the standpoint of availability of specialized retail facilities, is in the 50,000-100,000 range.

In determination of the population base for retail facilities, more conclusive results should be obtained. To assist in developing desirable fundamental forms which an urban pattern may assume, additional studies dealing with differentiation of retail functional areas, are also required.[50]

(9) *Churches and Voluntary Associations.* The population base required for a church varies with city-size. Several estimates for a fixed population base range from 700[51] to 1,000 or 1,500[52] persons, all of which are of concern primarily to planning units with the city. Duncan estimated a minimum base of 450, and that in a city of 10,000, 13 churches might be required.[53]

Voluntary associations, including such groups as Elks, Rotary, Lions, and Boy and Girl Scouts, are difficult to analyze, due to the absence of adequate data.

[46] Robert M. Lillibridge, "Shopping Centers in Urban Redevelopment," *Land Economics*, May 1948, pp. 137-160.

[47] Clarence Schettler, "Relation of City Size to Economic Services," *American Sociological Review*, February 1943, pp. 60-62.

[48] Otis D. Duncan, *op. cit.*, pp. 198-204, retail facilities discussion.

[49] John Adams Pfanner, Jr., "A Statistical Study of the Drawing Power of Cities for Retail Trade," *Journal of Business of the University of Chicago*, Vol. XIII, No. 2, Part 2, April 1940.

[50] Don J. Bogue, *op. cit.*; and Walter Isard and Vincent Whitney, "Metropolitan Site Selection," *Social Forces*, March 1949, pp. 263-269.

[51] American Public Health Association, Committee on the Hygiene of Housing, *op. cit.*, p. 50.

[52] National Resources Committee, *Urban Planning and Land Policies* (Washington: G. P. O., 1939), p. 138.

[53] Otis D. Duncan, *op. cit.*, pp. 205-213, discussion of churches and voluntary associations.

From crude analysis by Duncan, the findings might be generalized as follows: the large city is apt to have a greater variety of associational life than the small city. It will be able to contribute more heavily in a financial way to activities of its organizations. But as far as particular associations are concerned, their scope and influence in the community may be greater in small cities.

(10) *Family Life.* Theorists, in discussing urban size, stress the general desirability for family life of the smaller cities as contrasted to larger cities. This is somewhat confirmed by Duncan's study of marriage, fertility, and housing data.[54]

Among the native white population, 18 to 64 years of age, that study indicated that the proportion of married persons is over 10 percent greater in cities of 2,500 to 25,000 than in cities over 250,000. It is well known that the largest cities do not reproduce their own populations but depend on in-migration, in addition to natural increase, to maintain and increase their populations. The breaking-point in the 1940 data appear to be around 100,000 for the white population. The city-size groups above this point have an average replacement index of 65 to 70; whereas cities of 10,000 to 100,000 have sufficient fertility for 75 percent replacement, and cities 2,500-10,000, 85 percent. There is also an inverse relation of city-size and fertility for the non-white population, but the difference by city-size groups is smaller than for the white population.

Housing characteristics data are exceptionally detailed. In that analysis of 1940 data, it appeared that the small city resident can own a home more easily, free of mortgage or, if he rents, will pay less rent. Dwelling units in large cities generally have better equipment, but the preponderance of single-family, detached structures in smaller cities probably places the balance, as regards desirable family life, with the smaller cities.

(11) *Psychosocial Characteristics.* Many factors regarding urban life are difficult to categorize and analyze. Branch in his public opinion sampling "satisfaction score," attempted to reach these.[55] He concluded that the greatest social contentment is found in communities of less than 25,000 people.

Some criteria emphasize the large city as the origin point for creative activities and social movements. Duncan's analysis showed that innovations occurred more often in large cities, and as a corollary, showed a diffusion of radio amateurs from large to small cities.[56] As far as individuals listed in *Who's Who* were concerned, that study indicated that cities greater than 250,000 have proportionately about twice as many as cities below that size. Inventions were indicated as most prevalent in medium size satellite cities of 25,000-50,000, and secondly prevalent in cities of the 100,000-250,000 range. Concentration of writers was indicated around New York City, and as a group were shown to be concentrated in very large cities and within the metropolitan region of those cities.

Conclusion

In review of the research in this field, it is readily apparent that there is a wide variation in the reliability and comparability of basic data. It is also apparent that, in rational development according to a city plan, guidance may be given to bring about more desirable results than are present in most existing cities. Despite these major reservations involved in acceptance of conclusions, certain conclusions are warranted as follows:

[54] Otis D. Duncan, *ibid.*, pp. 214-226, family life discussion.

[55] Melville J. Branch, *op. cit.*, p. 31.

[56] Otis D. Duncan, *op. cit.*, pp. 227-236, discussion of psychosocial characteristics.

a. The size of an urban area does have definite relation to its success in functioning. This is revealed not only by study of criteria, but in study of specific cities.

b. The urban function generally is measurable, with the degree of success given as an optimum size range rather than as a definite and specific number.

c. In measurement of the various criteria, optima are indicated by criteria, but not for major categories of criteria. For instance, as Duncan emphasizes, the category of "health" turns out to be virtually meaningless as a criterion of city-size. However, if "health" is broken down into more specific variables, like infant mortality, etc., an optimum range of city-sizes can be approximately indicated.

d. In measurement of size for a specific urban situation, the result will be a compromise between optima for the various components of the urban function. For instance, residential functions for an independent city might indicate the need for a population of about 50,000 and the industrial base might require more of a population base, but not sufficient additional population to warrant establishment of a separate city. For that specific urban area, municipal efficiency studies would be required for final urban-size determination.

e. For many criteria involving residential functions, as access to open areas, health, public safety, recreation, and family life, it appears that cities of around 50,000 may be most desirable.

f. Many criteria indicate the necessity for a population base, ranging from 100,000 to 300,000 for certain types of industrial activity, certain professional schools, and certain types of recreation and retail facilities as well as for a relative degree of municipal efficiency.

g. On the basis of present knowledge, more specific conclusions as to desirable urban size, are not warranted.

h. The varying optima for residential and other functions, validate the need for area differentiation within metropolitan districts for maximum compatibility of function components.

i. The need for research to reveal urban function and size relationships, certainly is evident. The functional character of the urban pattern requires more detailed definition, both as to activity within the urban area and as to the place of the urban area within the total urban pattern or "constellation" as graphically titled by Tyrwhitt. Criteria may thus be evident which will allow measurement results to be more readily correlated with function. All studies reviewed necessarily involve use of rather inadequate basic data. Basic data not only need to be collected and collated specifically for urban size study, but methodology also requires exploration.

In relation to the city plan, it is apparent that exploration is needed to translate these requirements of multi-functional urban areas, as revealed in criteria analysis, into desirable concrete terms. The pioneering of Ebenezer Howard was a beginning in this direction. However, it is apparent that establishment of new cities, growth limitation of existing cities or decentralization, without realization of necessary population base, the implications of total city size, or requirements of all aspects of the urban function, may cause as serious maladjustment in land use as is apparent in the sprawl of the contemporary urban pattern.

Research in these fields constitutes an opportunity in which the various disciplines concerned with urbanism may well cooperate. The social scientists and geographers (who already have contributed much to our knowledge) as well as those concerned with economics, urban land economics, public adminis-

tration and city planning, may find that they can make major contributions to such research and also thereby secure much needed guidance.

Results of such research may do more than to merely increase our academic knowledge of the urban pattern in its constant evolution. They may assist in formation of more desirable urban forms which not only may provide a more desirable environment for family life, but allow public and private improvements to be maximized as enduring investments.

Attitudes Relating to Mechanization and Farm Labor Changes in the Yazoo-Mississippi Delta†

By HARALD A. PEDERSEN*

THE problem selected for investigation in the project from which this analysis is derived is the relationship between the spread of mechanization and the concurrent changes in farm labor and farm population. It is the usual assumption that as farm operations are mechanized the farm labor force decreases. This study assumes that the Cotton Belt in general and the Yazoo-Mississippi Delta, in particular, present a unique phenomenon in that the relationship between mechanization and manpower is less direct than in other farming areas. The unique aspects of the phenomenon result from the nature of cotton production itself and from the value systems of the plantation culture.

The specific questions to be considered are: (1) What is the attitude of the plantation operator toward mechanization? (2) What is the attitude of the operator toward available labor? (3) What is the attitude of the plantation laborer toward mechanization? (4) How will these attitudes affect the stability or mobility of the plantation labor force?

Farm population in the Delta can be shown to be more directly responsive to other phenomenon than to technological change in agriculture. Migration from farms in the Delta does, however, follow the pattern of migration observed for farm populations in the United States generally; that is, that migration from farms increases during periods of general business prosperity and decreases during periods of depression. Analysis of population data for the Delta before 1940 reveals but slight relationship between the increase in the number of tractors and changes in farm population before 1940. This was predominantly a period of depression. After 1940 the farm population declined sharply and the number of tractors rose rapidly. This has been a period of prosperity.[1]

The introduction of technological innovations in agriculture is contingent upon the availability of the innovation, its economic utility, and the attitudes of farm operators toward it. The attitude of farm operators toward any given innovation is determined by the configuration of behavior patterns that will be affected directly or indirectly by its adoption. The farmer's "definition of the situation" as it is now and as it will become when the innovation gains widespread acceptance is of primary importance in ascertaining the rate of adoption for any given innovation.

Successful mechanization of cotton production depends upon several technological innovations rather than upon a single invention. A partial list of inventions, not critical for other row-crops but essential for cotton, includes the mechani-

† This article is based on a paper read before the Fifteenth Annual Meeting of the Southern Sociological Society, March 27 and 28, 1952, in Atlanta, Ga., as Journal Article No. 280, Mississippi Agricultural Experiment Station. The data for the analysis are taken from "Mechanization and Farm Labor Adjustments," Mississippi Agricultural Experiment Station Project FQ-1, subproject A. The project is carried on in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture. Dr. Arthur Raper of the Bureau has worked closely with us in all phases of the study. The writer is indebted to him for numerous insights incorporated into this analysis.

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[1] Ernest H. Tucker, *Mechanization of Agriculture and Population Changes in the Yazoo-Mississippi Delta*, 1880-1950, MS Thesis (unpublished) Mississippi State College, 1950, page 50.

cal cotton picker, gin improvements in the form of cleaners and dryers, defoliants, herbicides, and flamers. The row-crop tractor, multiple-row cultivator, and planter also are needed, but these were perfected for row-crops before their introduction to cotton culture. They have had limited use in the Cotton Belt for 15 or more years, with more extensive use since 1945.

The Cotton Belt today stands on the threshold of a new era for the following reasons. (1) At the wage rates now prevailing the mechanical cotton picker, when supplemented with cleaners and dryers at the gin, can harvest cotton more cheaply than hand labor. This has been demonstrated in field operations.[2] (2) Under normal weather conditions the application of pre-emergence chemical weed killers can effectively control weeds for as long as 6 weeks after planting. Cultivation, flamers, and post-emergence chemicals can do the job from then on.[3] (3) Over-all operating costs per acre in cotton under fully mechanized operations have been demonstrated to be half the cost per acre under unmechanized operations and two-thirds of the cost under partially mechanized operations.[4]

The present analysis is concerned primarily with mechanization, that is, the substitution of machine power for animal power and human labor. It is concerned only incidentally with other aspects of technology. The analysis is limited to the human element in the progress of mechanization, that is, the impact of the attitudes of farm people and the values of rural society in the Cotton Belt upon technological change. Finally, it is concerned with the relationship between technological changes in agriculture and farm labor and population.

The Method of Study

In this analysis, the plantation is the sampling unit.[5] Findings are based on observations on 35 medium and large plantations in Bolivar County, Miss.[6] Bolivar County was selected as the survey county because it is a modal county as far as a number of items of production and management are concerned. The range of adjustments observed in the area approaches the range observed in the Delta at large.

The plantation was selected as the sampling unit because it has dominated the agricultural economy of the Cotton Belt since the emergence of cotton as a major crop in the area. It perpetuated the one-crop system and the dependence of the area upon hand labor. It fostered an aversion to manual labor and raised the status of both supervisor and landlord. They wanted land, not as an opportunity for independent work but rather as an investment necessary to the attainment of supervisory status. The plantation was the pace setter in mechanization. Tractors are on all plantations. The mechanical picker, the flame cultivator, the airplane as a farm implement, and chemical weed control were tested on the

[2] Grady B. Crowe, *Mechanical Cotton Picker Operation in the Yazoo-Mississippi Delta*, A Progress Report, 1950 (mimeo) Mississippi Agricultural Experiment Station in cooperation with the United States Department of Agriculture, Bureau of Agricultural Economics, page 25.

[3] *Chemical Weed Control Recommendations for Cotton in 1952*, Circular 171, Mississippi Agricultural Experiment Station, January 1952, page 6.

[4] Grady B. Crowe, "The Economic Implications of Mechanization in Cotton Production." A paper presented before the Agricultural Economic and Rural Sociology Section of the Southern Agricultural Worker Conference, Atlanta, Georgia, February 6, 1952, (mimeo) page 11.

[5] The small farm ranging in size from 40 to 399 acres, with roughly 50 percent of the land planted to crops, is primarily a family operation—the family supplying the labor necessary for its operation—and for this reason is not considered in this analysis.

[6] Plantations included in the survey were selected by interval sampling from a complete listing of the large plantations, and by area samplings for medium plantations. An enumerative schedule was obtained from each plantation operator in the sample. A schedule was also obtained from the head of each resident labor family on selected plantations together with a supplementary schedule for each worker in the family.

plantations in the area. As each new invention gains widespread adoption it is on the plantations that the greatest reduction in manpower will occur.

The Operator and Mechanization

Tractors or Mules. Plantation culture is characterized by conflicting values. A plantation is a big business. It is an economic unit that requires a high level of managerial ability. It is also a social unit founded on primary relationships between management and labor, between the big house and the little house.

The cotton plantation is being mechanized. The all-mule plantation is a thing of the past. Both tractors and mules are found on all units. The most mechanized plantation in the survey, with 21 tractors and only 12 mules and 70 percent of its cotton harvested mechanically, tolerates the survival of two tracts on the plantation that have never been touched by machines. One tract is operated by a renter (with four mules and his family labor) who does all the work from stalk cutting to picking. The other tract is operated by a share cropper who is the oldest son of the renter. The landlord furnishes the cropper three of the 12 mules on the plantation. Like his father, the cropper performs all operations from stalk cutting to picking with the mules and his family labor.

In the survey sample only 40 percent of the operators consider tractor power the most economical source of farm power. More than half of the operators feel that efficient operation of the plantation can best be attained through a combination of tractor and mule power. If the level of mechanization of the operation is taken into account, 50 percent of the respondents for units that have attained a relatively high degree of mechanization express the opinion that tractor power is the most economical. Sixty-one percent of the low mechanization group favor a combination of tractor and mule power. (Table I).

TABLE I—Operator Preference for Tractor Power or Mule Operations by Level of Mechanization of the Plantation, Bolivar County Survey, 1950.

Type of Power	Total	Level of Mechanization	
		High	Low
Number of Farms	35	12	23
Total	100.0%	100.0%	100.0%
Tractor	40.0	50.0	34.8
Combination	51.4	33.3	60.9
Mule	8.6	16.7	4.1

This is the planter paying homage to the mule, the faithful beast of burden of the Cotton Belt. So what are the jobs for which the mule must be retained? Eighty percent of all operators feel that the tractors can be used effectively for all operations performed on the farm, with the exception of chopping and picking. Cultivating is the only major operation considered by a significant number of operators to be better adapted to mule operations. Yet, only 34 percent believe that a man and a mule will do a better job of cultivating than tractor equipment. Plowing water furrows, working gardens —these are the jobs that can be accomplished better with mule equipment, in the opinion of a fourth of the operators. The planter's evaluation of the utility of the mule on plantations is low. Among the operators who have attained a relatively high level of mechanization, the potential usefulness of the mule is thought to be even lower.

Tractors or Manpower. There remains considerable skepticism among operators as to the feasibility of converting to tractor power for specific operations. Weed control and picking are the more

frequently mentioned operations which in the opinion of the operators are least adaptable to mechanization. These operations require the substitution of tractor power for human labor rather than for animal power. Eighty percent of all operators believe that this equipment is inefficient or they do not know whether the equipment can do the job. Operators on plantations with a relatively high level of mechanization have seen the various techniques in operation but still the judgment of 66 percent is that the equipment does not do the job effectively.

This skepticism is further illustrated by an incident which occurred on one of the plantations in the sample. This particular plantation is one of the most highly mechanized included in the survey. On one of the days that the interviewer was on the plantation the operator was experimenting with a new herbicide and application method. There was, to put it mildly, great ferment on the plantation. Representatives from the chemical company and from the implement company, as well as a smattering of neighbors were on hand. Everyone was talking about the nozzle for the sprayer and demonstrating the principle involved. Some weeks and several rains later we returned and, having been in on the great experiment, we inquired about the results. The apologetic response was, "We didn't have a very good test. The field on which we were trying it out is quite low. We didn't get a very good stand and it's been wet most of the time since so we finally plowed it up when we were able to get into the field again last week."

It is also important to note that the "great experiment" was carried on, not on the good cotton land, but on the marginal land which is written off if the workers get behind or if there is too much rain. The plantation has averaged 600 to 800 pounds of lint cotton per harvested acre for the last 10 years. About 1200 acres of good cotton land is planted and harvested each year, regardless of cost. In addition, three to five hundred acres are planted and harvested —controls, weather, and labor supply permitting.

Mechanization—Why not now? In response to the question "What are the most important factors retarding mechanization on your plantation?" the cost factor in relation to size of operation is most frequently mentioned. One operator admitted that he was frequently heckled by his more "progressive" neighbors for keeping all those mules. His stock response, "I can still pay my bills. That's more than a lot of the flame-cultivator and cotton-picker boys can say."

What is the cost? Piecemeal mechanization is difficult. Tractors can be added, yes, but they will be useful for only two months out of the year, unless a complete reorganization of operations is effected. One operator who is still doing much of the work with croppers and mules remarked, "If I only knew for sure at planting time which of the 60 families would get behind this summer I could plant their cotton with a tractor. Then I would be able to cultivate it with a tractor. But we always miss four or five. Once you start with mules, it's mules all the way." Reorganization means more tractors and less work for the croppers—also less money, less satisfaction.

Tractors with four-row equipment cost $3,000. But these do not take care of the chopping. Hand labor is still needed for this. One-row cotton pickers with tractor cost $8,000. But if you change to machine pickers the plantation gin must be remodeled. The cost?—$60,000 minimum. Piecemeal mechanization is diffi-

cult but complete mechanization is costly.

Labor is also mentioned as factor that tends to retard mechanization. Both available labor and labor not available are important. One operator observes: "We have never found it difficult to 'keep' labor on this place. We treat them 'right.' We don't need to mechanize." Another operator complains, "It is almost impossible to find good tractor drivers. If you do manage to train one, somebody else is sure to offer him 50 cents more and he leaves you."

One of the techniques used to retain or attract skilled workers, such as tractor drivers and mechanics, is to let their wives have crops. The acreage alloted is somewhat less than the usual sharecropper tract, but it serves to perpetuate the attachment of the worker to the plantation. Tractor drivers and mechanics are paid by the day or by the hour. They receive a higher wage than do the regular wage hands. Good drivers and mechanics usually have relatively constant work throughout the year, but the bottom half of the list may not have enough work. Mobility is highest among the drivers at the bottom of the list.

Both cost and labor factors are given as reasons retarding mechanization by less than a third of the operators. Other reasons for not mechanizing further are personal and cover a wide range. One fifth of the operators were not interested in further mechanization. Nearly 50 percent responded with particularized reasons such as "land too low," "too much buckshot land," "fields too broken up" and numerous other rationalizations.

One factor stands out from the remarks of the operators. Cotton chopping is still defined as a hand operation. In normal years, a field hand can chop roughly twice as much cotton as he can pick. Many operators use this as a crude measure of the extent to which they can mechanize. The planter must assure himself of adequate labor to chop the cotton. This is accomplished either through "arrangement" with "truckers" who haul workers from towns and cities to the plantation or through the conventional sharecropper arrangement on half of the land. One planter commented about an exceptionally fine field ready for harvest: "I'm saving that out for my truckers. The field is insurance to get enough cotton choppers next summer." The other adjustment works like this. "The only jobs a cropper has to do are chop and pick. When he finishes in his field we let him work in the day crop for wages. We charge the machine work against his tract and pay him cash for work on the day crop. The two just about balance out but he gets cash all summer long. It cuts down on advances but also cuts down the size of the final settlement. This gives me a readily available labor supply on the plantation." The ratio of day-crop to cropper cotton on this unit is nearly two to one.

At present, the planter is faced with a dilemma. Complete mechanization of the operations that can be mechanized will jeopardize his ability to hold labor for the one operation which up until now has not been mechanized successfully. The techniques may be available, but they have not been demonstrated to the satisfaction of the plantation operator. Chemical weed control and flame cultivators are not as yet practicable for the average plantation. For the present, a plantation operator's judgment of available tractor equipment will dispose him to continue to compete for labor and to mechanize only as much as is necessary to fill the gap between labor demand and labor supply.

The Operator and the Worker

It is a commonplace idea that it isn't possible to have too many workers on a

plantation. Therefore, it may be that the judgment of 90 percent of the planters that the supply of farm labor is below the demand is biased. There is some differences of opinion as to the nature of this shortage. Operators on plantations that have a low level of mechanization tend to stress the shortage of seasonal workers and sharecroppers in that order. Operators on plantations that have a high level of mechanization tend to stress the shortage of skilled workers —particularly tractor drivers. (Table II).

TABLE II—THE OPERATOR'S EVALUATION OF THE AVAILABILITY OF FARM LABOR BY TYPES OF WORKERS AND MECHANIZATION LEVEL OF PLANTATIONS, BOLIVAR COUNTY SURVEY, 1950

Availability	Total Number	Level of Mechanization	
		High Number	Low Number
Number of farms	35	12	23
	100.0%	100.0%	100.0%
Adequate supply, (%)	11.4	8.3	13.0
Inadequate supply, (%)	88.6	91.7	87.0
Seasonal	22.9	8.3	30.4
Croppers	17.1	8.3	21.7
Skilled	14.3	33.3	4.3
Unspecified	34.3	41.8	30.6

Nearly a third of the operators point out that the labor shortage is more apparent than real. There are plenty of workers but they do not want to work at the wages operators are willing to pay. Farm workers are gravitating to nonfarm centers and the nonfarm labor pool is becoming increasingly large. The worker's explanation is that a nonfarm resident can get almost as much work as the resident labor family in normal years and that he is paid the prevailing wage, which has consistently been one and a half to two times as much as the wage paid resident laborers for work on the day crop. To be sure the resident laborer has a share in a crop, in addition, but the consensus seems to be that even that fails to equalize the return.

Operators, however, are prone to lay the blame for the labor scarcity upon the various welfare payments. First it was WPA, now it is soldiers' allotments, aid to dependent children, and old-age benefits. "It's getting to where a man doesn't have to work any more."

Operators are generally in agreement that the labor available today, when compared to that available before World War II, is both less willing to work and less dependable. This is the judgment of 57 percent of the operators with respect to each trait. Another 31 percent is inclined to detect no appreciable change. (Table III.)

Operators feel that workers are capable of doing a better job now than formerly although there is less agreement on this than on the two traits noted above. Nonetheless, the operators justify their contention by reference to the higher level of educational attainment, and to the wider experience with mechanized equipment.

Operators are caught in a crossfire. The traditional methods of control over labor are breaking down and the manager finds himself needing to make concessions to labor. Each operator feels he is beyond reproach, but that somebody is always upsetting the apple-cart. First, it was cash-furnish—some fellow down the road closed the commissary and "furnished" his tenants in cash. Now everybody has to "furnish" in cash. Then it was housing improvements, then Farm Security, then electricity and access to the road. "What next—nobody knows! But if it keeps up this way I'll be forced to mechanize. The labor you get now is so sorry." Planters' attitudes toward available labor are pushing them into accepting techniques that they do

not understand and in which they have little faith, but which are effectively moving them toward more complete mechanization of operations.

TABLE III—THE OPERATOR'S EVALUATION OF HIS LABOR FORCE COMPARED TO THE PREWAR LABORERS, BY MECHANIZATION LEVEL OF THE PLANTATION, BOLIVAR COUNTY SURVEY, 1950.

Attributes	Total	Level of Mechanization	
		High Number	Low Number
Number of farms	35	12	23
Willingness	100.0%	100.0%	100.0%
more	14.3	41.7	....
no change	22.9	16.7	26.1
less	57.1	41.6	65.2
no answer	5.7	....	8.7
Dependability	100.0	100.0	100.0
more	2.9	8.3	....
no change	31.4	25.0	34.8
less	57.1	66.7	52.2
no answer	8.6	....	13.0
Capability	100.0	100.0	100.0
more	28.7	33.3	26.1
no change	45.7	58.4	39.2
less	17.1	8.3	21.7
no answer	8.6	....	13.0

The Worker and Mechanization

The Family Heads. Plantation workers are less specific in their reactions to mechanization. Seemingly, they have come to accept the fact that there is slight relationship between the amount of work performed and the remuneration received. Twenty years ago, or even ten years ago, the work season began with plowing in March. From then until the last boll was picked the family head had few free days.

In March also tenants can draw the first installments of the "furnish" for the ensuing year. This arrangement persists even though work for the cropper on the more mechanized plantation doesn't get underway until planting or after planting when the cotton shows green in the row. The heavy work is done with tractors on most plantations today and on some the planting is done with tractors. For as mentioned above, "If you start with mules, it's mules all the way." Cultivating, too, is done with tractors on many plantations. Chopping and picking are now the only operations performed by the cropper on many plantations.

Where does the cropper prefer to work? On the tractor plantation, of course. Sixty-seven percent prefer the tractor plantation. The proportion is 75 percent for croppers working on plantations with a high level of mechanization; it drops to 64 percent only on plantations that still depend to a considerable extent on mules.

The assumption that the work can be done faster and that the work of the cropper is easier are the primary reasons given for their preferences. "A man can sure do a lot of walking behind a mule," is characteristic of the remarks made by the workers.

Workers who prefer to work on mule plantations give less consistent reasons for their preference. They tend to object to specific situations which arise on tractor farms rather than to express a positive preference for mule operations.

When a plantation worker thinks about "trading" for a crop at a new place, mechanization is conspicuous by its absence as a factor to be considered. Not one cropper mentioned the presence or absence of tractors as a determinant in his choice of a plantation. Factors that were important, listed in order of frequency of occurrence, are: (1) the reputation of the manager or owner, (2) the kind and amount of furnish, (3) the condition of the house, (4) the kind of land, and (5) the general treatment of tenants. The rank order is the same for tenants on plantations with high or low levels of mechanization.

The Male Workers. There are 109 male workers on the 35 survey plantations.

Less than a third of the male workers call themselves tractor drivers. The proportion on plantations with a high level of mechanization is exactly one third. What is even more significant is that only a third of the male workers who claim no experience as tractor drivers express a desire to drive or to learn to drive tractors. The same general relationship exists in regard to the desire or interest of male workers in learning to service and repair tractors. Only a fifth of the workers claim some skill or experience in service and repair of equipment; but nearly half of the inexperienced are interested in learning.

In general, the conclusion seems warranted that plantation laborers are not disposed to "have any truck" with the new ideas which are taking over on the plantation. Plantation workers are content to continue in the role of seasonal workers, which the plantation management in the quest for efficiency has forced upon them.

The reason for this preference is illustrated by a story told by a planter who had just remarked: "It used to worry me that we aren't overrun by boys wanting to drive tractors for us. We pay them better than most and we treat them right, but we get no takers." Then he told this story. A planter was going fishing. He called a little Negro boy over to go along and row the boat. The following conversation took place. "How much are you going to charge me to row my boat today?" "Yas suh, boss, I'll row your boat." "How much?"—"Two dollars." The planter was a little taken aback by the price but agreed to pay. However, the more he thought about it the more convinced he became that he had been taken in by the boy. So he opened up the conversation again. "Do you live around here?" "Yas suh, boss, I work for Mr. Joe who sells you bait." "Does he pay you two dollars?" "No suh, boss he just pays me a dollar." It was obvious that further explanation was demanded so the boy presented the following. "Well suh, boss, Mr. Joe is in and out but when you and me is out in that boat you're there looking at me all the time." He got his two dollars.

On the plantation it's called supervison —close supervision. A large plantation sends four or five tractors into the field and there is a man—a supervisor or foreman—at each end of the row "looking at them—all day." The responses of the workers indicate that they prefer the traditional role of cropper or day laborer to the more closely supervised semi-skilled or skilled occupation of drivers, if they stay on the plantation.

Summary

The Yazoo-Mississippi Delta, to repeat, is on the threshold of a new era. Delta planters are skeptical of and unfamiliar with many of the new techniques being introduced to cotton production. In general they are willing to accept the substitution of tractor power for animal power. The economies attainable are accepted and known; the primary retarding factor in this transition is the scarcity of trained and dependable operators. Planters try to overcome this deficiency by close supervision.

Planters are less certain when they are faced with the substitution of tractor power and other technological innovations for human labor. Cotton chopping, in particular, continues to be a hand operation in the minds of planters. Cotton picking can be done better by hand if dependable workers can be obtained. But the workers available are not dependable and a planter finds himself looking more and more at the work of the mechanical picker down the road. He sees the cotton in the hopper rather

than the cotton left in the field. Complete mechanization of picking will not occur this year or the next but the planter is getting ready. For years he will save out enough good cotton to assure himself of ample workers for the chopping season.

Unless a sharp general business recession occurs, the rate of mechanization is likely to be determined by the field hands rather than by planters. In their own minds field hands are already displaced for they see their type of labor less and less needed. They have entered the migratory movement from farm to village to urban centers. When opportunity knocks they move. Opportunity does not appear in training for more skilled occupations on the farm but in migration.

Migration from the Delta will continue to be high. Delta planters will continue to pressure for migratory seasonal workers and to experiment with innovations they do not understand. Complete mechanization of the Delta is a possibility, but it is not likely to become a reality within this decade, perhaps not within the next.

Land Utilization in Taiwan

By TE-TSUI CHANG*

TAIWAN, more commonly known as Formosa, is primarily an agricultural region and this article concerns itself chiefly with the utilization of agricultural land, including forest land, in that province.

1. Land and Population

The total land area of Taiwan (including the nearby small islands) is about 35,961 square kilometers (13,881 square miles), or about 8,882,400 acres. For comparison, this is slightly more than the combined areas of Connecticut and Massachusetts. High mountains stretch from the north to south covering all the eastern and a large part of the central region of the Island. Only the western part is relatively level and has fertile soil. Over 60 percent of the total land is mountainous and of little agricultural value, although most all the area is covered with trees. There are approximately 5 million acres of forests in Taiwan, and forest land accounts for a larger acreage of the land surface than any other major use. Next to farm products, forest products have contributed most to the economic progress of the province.

Nearly level plains occupy approximately 3,186,300 acres, or 36 percent of the total area of Taiwan. Of this plain land, 2,156,210 acres, or 68 percent, are used for agricultural production; 111,510 acres, or 3.5 percent, for building sites (including urban land); and about 30,000 acres, or nearly 1 percent for communications.

Among the 2,156,210 acres of agricultural land, 1,312,250 acres, or 61 percent, are paddy fields; 805,600 acres, or 37.3 percent, dry fields; and 38,360 acres, or 1.7 percent uncultivated land used for fish ponds, pastures, grazing grounds, etc. During the past forty years the economic supply of land has been continuously increasing because of the development of communications and the improvement of irrigation and drainage. In 1900, agricultural land amounted to 858,098 acres, or only 9.7 percent of the total land area, but by 1950 the percentage had increased to 24 percent. Land for highways and railroads also increased from 0.2 percent in 1930 to nearly 1 percent in 1950. Paddy fields occupied only 480,800 acres in 1900. Now they have been extended to more than 1,312,000 acres, with a corresponding decrease of dry fields.

The population of Taiwan has been increasing rapidly during the recent 50 years. According to statistical records of the Provincial Government, in 1900 the total population was only 2,750,511, but at the end of 1951 the number was about 7.6 million, or an increase of nearly threefold within half a century. High birth rates and a vast influx of immigrants are the two causes of population expansion. In Taiwan the birth rate has been generally higher, and the death rate lower, than that on the continent of China, so the natural increase of population usually has been greater than in most other provinces of the country. Since 1947 the activities of Chinese communists on the continent have forced a large mass of people from the communist areas into Free China. This mass immigration on the one hand, and the high rate of natural increase on the

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other, have produced the very rapid population increase.

The natural increase of population in Taiwan is already abnormally great, but the rate of increase is still rising. In 1905, the rate of natural increase was only 5.3 per thousand; in 1909, it increased to 14.1; in 1920, it became 17.6; in 1930, it was 25.5; and in 1948, it increased to 26.5. The figures of natural increase of population in most countries are generally below 10 per thousand. For instance, in 1944 the natural increase of the United States was 9.6, and that of England was 5.9. According to an investigation on farm population made by Prof. J. L. Buck in 1929-1933, the natural increase on the continent of China was about 11.2 per 1000 inhabitants. These figures are quite sufficient to prove that the birth rate in Taiwan is comparatively high.

Before 1905 there was no record of the number of families in this Province. The first general census was taken on October 1, 1905. It showed the total population to be 3,039,751, the total number of families to be 487,753, or an average of 6.2 persons per family. Several census registrations after 1905 indicated that the average size of family varied from 5.7 to 6.4 persons, but in most of the census years the figures exceeded 6 persons. On the continent of China, according to Agricultural Surveys made by Prof. Buck in 1929-1933, the average number of persons per family was about 5.2. We may conclude that the size of family in Taiwan is generally larger than in most other parts of China.

The population of Taiwan was 2,750,-511 in 1900; 7,561,332 in 1950. The result has been an increase in the number of persons per square mile, from 198.1 in 1900 to 544.6 in 1950. The *increase* in density fron 1945 to 1950 was 111.4 per square mile because of the large migration from the mainland.[1]

II. Farm Land and Farm Population

Even though the population of this province has increased very rapidly, the increase has always been accompanied with an increase of agricultural production. Population expansion is generally encouraged by increasing means of subsistence. This is quite in accordance with the Malthusian principle that people will multiply at a greater rate when food is plentiful. As long as the rate of population growth does not exceed the rate of increasing agricultural production, the increase of population is probably beneficial to the society in certain aspects.

Agricultural production may be expanded in either one of the two following ways: (1) the increase of acreage to be cultivated; and (2) the increase of intensity of cultivation. In Taiwan, fortunately up to the present, the growth of total population as well as farm population has been very closely correlated with the expansion of farm land. If we take 1900 as the base period for calculating the index numbers of total population, farm population, and farm land, then the index of increase of farm land for 1950 was 251, that of farm population was 229, and that of total population was 275. These figures show very well that the increase of farm population, total population, and farm land, were almost at the same rate. The increase of farm land is chiefly due to the extension of communication lines, the development of irrigation and drainage, and improvements such as changing wood land and prairies to arable land and changing dry fields into paddy fields. The farm population was 64.9 percent of the total population in 1900 but has shrunk,

[1] Statistical data used throughout this article have been compiled from figures appearing in the *Taiwan Agricultural Yearbook*.

relatively, during each five-year period thereafter. It was only 54.2 percent of the total population in 1950.

TABLE I—INCREASE IN FARM LAND, TAIWAN: 1900-1950

Year	Total farm land acres	Paddy fields % of total	Dry fields % of total
1900.....	858,097	56.0	44.0
1905.....	1,542,518	48.8	51.2
1910.....	1,665,027	49.3	50.7
1915.....	1,729,198	49.0	51.0
1920.....	1,851,065	49.0	51.0
1925.....	1,915,406	48.2	51.8
1930.....	2,005,926	48.8	51.2
1935.....	2,052,577	57.6	42.4
1940.....	2,125,284	61.6	38.4
1945.....	2,015,560	61.9	38.1
1950.....	2,156,210	60.8	39.2

From the above figures we know that the area of paddy fields increased much more rapidly than the increase of dry fields, especially after 1930. During the recent 20 years every effort has been made to convert dry fields into paddy fields by means of irrigation in order to increase the supply of food.

The ratio of cultivated land to total land area is called the "index of cultivation." This index is higher in Taiwan than in Japan or Korea, or in many other provinces of China. The following table compares the Index of Cultivation for Taiwan with indices for adjacent regions.

TABLE II—INDEX OF CULTIVATION, TAIWAN AND ADJACENT REGIONS

Regions	Index of cultivation	Regions in China Proper	Index of cultivation
Taiwan.....	24.0	Kiangsu	52.4
Philippines.....	23.5	Chekiang	26.7
Korea.....	20.1	Kiangsi	16.7
Japan.....	15.8	Kwangtung	12.4
China Proper.....	9.1	Fukien	11.8

The amount of farm land in Taiwan is strictly limited by natural conditions. Land for cultivation is mainly distributed over the coastal plains, especially the western coastal plains, for which the index of cultivation is over 43 percent. The central and eastern parts of the Island are mountainous with some peaks as high as 3,500 meters above the sea level. The hilly land is covered with forests, and its index of cultivation is only 2 percent. Arable land drawn into use is approaching its maximum. It has been estimated by specialists that the largest index of cultivation in Taiwan will be no more than 25 percent, that is to say the amount of arable land will not exceed one-fourth of the total land area. After that maximum limit has been reached, efforts to increase agricultural production must be concentrated on a definitely restricted land area, taking the form of greater intensity of cultivation with its consequence of lower average output per worker.

III. Types of Land Utilization

Primary industries, including farming, forestry, and fishing are the main industries in Taiwan. There are about 4 million people (farmers and their families) directly engaged in land cultivation. The farm population comprises 54 percent of the total. Approximately one million (including family members) or 13 percent of the total population, are directly engaged in fisheries and forest production (planting of trees, forest management, logging, paper and camphor industries). The total value of farm products usually accounts for over one-half of the total value of all goods produced in this province. Furthermore, the main factory industries, such as sugar and camphor manufactures and the processings of tea and some food supplies, all use agricultural products for raw materials. It has been estimated that over 80 percent of the manufacturing industries in Taiwan are of agricultural origin. These statements are enough to show that agriculture is of paramount importance to Taiwan.

Because of the large farm population and the limited amount of farm land, the the size of farms is generally small. Take the figures of 1950 for instance, when the total farm land was 2,156,210 acres, the total farm population was 4,098,290 and the total farm families were 646,042. On the average, each farm family had 3.3 acres and each farm person had only 0.52 acre of land for cultivation. Data based upon the agricultural survey of 1940 show the number of farm families and sizes of their farms as follows:

Size of farm	*Number of farms*	*Percentage of all farms*
Under 1.2 acres	111,805	25.61
1.2—2.4	90,007	20.62
2.4—4.8	113,117	25.91
4.8—7.2	57,521	13.17
7.2–12.0	41,749	9.56
12.0–16.8	13,129	3.01
16.8–24.0	5,938	1.36
24.0–48.0	2,796	0.64
Over 48.0	531	0.12
Total	436,593	100.00

The above figures show that over 70 percent of the farms in Taiwan are under 4.8 acres in area. Production on such a small farm can hardly maintain a suitable standard of living for a family with about six persons. Thus, a great majority of the farmers live in a state of poverty.

In order to obtain as much production as possible from the small-sized farms, the intensity of cultivation is pushed to a high degree. The purpose of cultivation in Taiwan is to get the greatest return per acre rather than the greatest return per unit of labor, because farm labor is cheap while farm land is dear. The way to increase intensity of cultivation is (1), by increasing the area in crops and the multiple crop index and (2), by selecting intensive crops, such as rice and vegetables, which consume a larger amount of labor and produce a greater amount of food value per acre than other crops.

Taiwan is situated in the sub-tropical region with high temperature, plenty of sunshine, and abundant rainfall. The growing season is very long; therefore, most of the cultivated fields may have two or three harvests every year. Thus, the number of crop acres is much greater than the total of cultivated land. Take the average data of 1938-1942 for instance, the total area of cultivated land was 2,120,137 acres, but the total harvested acreage (or the total crop acreage) was 3,370,466 acres, i.e., the multiple crop index was 159.

Among all kinds of cultivated land, the double-cropped paddy fields are the best and most fertile. Such fields occupy about 38 percent of the total area of cultivated land, and their multiple crop index is the greatest among all agricultural lands. They are called double-cropped fields because in them there are at least two harvests of rice per year. In addition to that, intermediate or supplementary crops are sometimes planted between the two seasons of rice, so that there may be three harvests per year, or five harvests in every two years. The multiple crop index for these fields is usually over 200. Excepting double-cropped paddy fields, there are single-crop paddy fields, in which only one season's rice is planted per year. After the rice is harvested, other crops may be seeded in succession. The multiple crop index of single-crop paddy fields is generally between 150 and 200.

The intensity of cultivation may also be increased by applying more fertilizer and labor per acre for each crop. The quantity of fertilizer consumed per crop acre in Taiwan is less than that used in Japan, but much greater than that used in the continent of China. Based upon the average figures of 1931-1934, the value of commercial fertilizers applied per crop acre in Taiwan was 21 yen

which equalled about 14 Chinese silver dollars at that period; but the same value used per crop acre on the continent at about the same time was only 1.2 dollars. This shows that the amount of commercial fertilizers consumed per crop acre in this province is more than 10 times that used in other provinces of the country. The amount of human labor used in Taiwan is also great as compared with most of the western countries. To grow one acre of paddy rice, for instance, the Taiwan farmers on the average use 42 workdays, but in the United States only about 5 work-days are required per acre of rice.

IV. The Chief Farm Products

Almost all kinds of farm land in Taiwan are used for the production of food; the production of fiber crops, such as cotton, silk, and jute, being negligible. Among the foods crops, rice is by far the most important. There are two kinds of rice: the paddy rice which grows in watered fields and the land rice which grows in dry fields. The former is the chief food crop in Taiwan as well as in other Southeastern Asiatic countries, or monsoon regions, and the latter is cultivated only in small amounts. In 1948, there was harvested in Taiwan 1,772,827 acres of rice of which 1,651,217 acres, or 93 percent, were paddy rice, and 121,160 acres, or 7 percent, were land rice. Rice has become the main crop of this province because natural conditions are suitable for its cultivation and, furthermore, because it can supply a greater amount of food energy per acre (in terms of calories) than most other crops. Food energy is a primary consideration in all countries with a high density of population. Paddy rice is one of the best crops for such countries if soil and climate permit.

The crop next to rice in importance is sugar cane, which is very popular in the central and southern parts of the Island. There is a common saying that "Northern rice and Southern sugar *is* Taiwan." This is because the weather in the north is warm and there is plenty of rainfall, both providing a suitable climate for rice; while in the south, the climate is very hot and comparatively dry, making conditions better suited to the growing of sugar cane. From 1939 to 1948, the ten years' average data show that the yearly total acreage of sugar cane was 298,864 acreas, or about 14 percent of the total farm acreage; the annual total yield of cane was about 7 million metric tons which was equal to about 700,000 tons of refined sugar. Among the chief agricultural products, sugar is the most important export commodity and makes the greatest contribution to the economic progress of Taiwan.

Other important farm crops are sweet potatoes, bananas, tea, pineapples, jute, peanuts, and citrus fruits. The following table gives an idea of the positions of the 10 major crops grown in Taiwan.

TABLE III—VALUE AND CROP ACRES OF TEN MAJOR CROPS IN TAIWAN
(1939-48 Average)

Crops	*Percent of total crop acres*	*Percent of value of all farm products*
Rice	48.3	47.1
Sugar cane	12.6	16.0
Sweet potato	12.4	6.5
Banana	1.6	2.2
Tea	3.7	2.0
Peanut	2.3	1.0
Pineapple	0.7	0.9
Tobacco	0.3	1.2
Jute	0.9	0.5
Citrus fruits	0.5	0.8

V. Conclusions

Taiwan is now a densely populated region, with an average of about 545 persons per square mile. This population density is greater than the density of such highly industrialized countries as

the United Kingdom, Germany, and Japan (the population densities of these three countries are all below 500 per square mile). But production in Taiwan is mainly agricultural. The almost exclusive dependence on agriculture in Taiwan means that the average standard of living of the people is very low.

In any agricultural country or region, the quantity of farm land is the chief determinant of production. In Taiwan, increases in population have been closely followed by increases in farm land, the rates of increase of the two being almost the same. But possibilities for further expansion of farm land will be limited, sooner or later, by natural conditions, while the growth of population, biologically speaking, could go on without limit. The highest attainable index of cultivation in Taiwan will be no more than 25 percent. Arable land drawn into use is approaching its maximum. In order to improve economic conditions, future progress in Taiwan should move along two pathways: (1) The growth of population should be checked, and (2) production should be increased in lines not now highly developed.

Based upon our own above analysis, we know that the rapid increase of population in this province during the recent years is due chiefly to the mass migration of people from the continent and the high birth rate of the native inhabitants. But the increase due to immigration may be a temporary situation, because the immigrants include a large number of armed forces and government officials withdrawn from the continent, and also a large mass of refugees. These people will return to where they came from when peace and order on the continent are restored. At that time the population of Taiwan will immediately decrease to about six millions.

The high birth rate of the native inhabitants is a serious challenge to their standard of living. If such a high rate of natural increase is not checked, a state of acute over-population will be reached in a short period.

As for production, there is room in Taiwan for the development of agricultural as well as manufacturing industries. It is true that there are very few mineral deposits of importance in this province; therefore, heavy industries cannot be built. But chemical industries using forest products as raw materials, such as manufacturers of paper, artificial silk, etc., may be greatly extended.

Agricultural production, including farming, forest, and marine products, may also be increased to a much greater extent than at present. As has been said, the intensity of cultivation in Taiwan is comparatively high, but the intensity is still far from its highest point. Compared with Japan, the cultivation in Taiwan is more or less extensive. Take the cultivation of ponlai rice for instance. During the four years, 1931-1934, average data shows that the cost of fertilizers used per hectare in Taiwan was 51 yen, while that in Japan was 81 yen, or the expense for fertilizers per hectare in Taiwan was only 57 percent of that in Japan. The number of labor days used per hectare in Taiwan was 103.56, while that in Japan was 210.74, i.e., the quantity of labor used per hectare for the cultivation of paddy rice in Japan was nearly twice as much as that in Taiwan.

High intensity of cultivation means high yield of products per acre. For most crops, the average yields per acre in Japan are much greater than that in Taiwan. The following table shows a brief comparison.

From the above figures we see that the average yield per acre in Japan is much higher than that in Taiwan. If the

intensity of cultivation in Taiwan is pushed to the same degree as in Japan, farm production may be considerably increased.

TABLE IV—A Comparison of Average Yields per Hectare between Taiwan and Japan (1938-1940 Average) *

Crops	Yield per hectare in Taiwan	Quintals Japan	Yield in Taiwan as percent of that in Japan
Paddy rice.....	25.12	36.80	68.26
Upland rice....	13.56	33.77	40.12
Wheat.....	13.97	26.57	52.58
Corn.....	16.81	20.84	80.16
Soy beans.....	8.71	14.58	59.74
Sweet potatoes.	114.55	129.64	88.36

* The figures concerning the intensity and yield in Taiwan and Japan are based upon the land utilization investigation made by C. S. Chen, Associate Professor of the University of Taiwan.

The production of forests and fisheries also can be expanded to a considerable extent. It has been estimated that the forest area can be extended to about 5.5 million acres, and in each acre, the number of trees may be increased from 2 to 10 times as much as in present stands. Coast and deep-sea fisheries can be developed without limit. If the growth of population is checked properly, and production along various lines increased as suggested, Taiwan will develop into the most beautiful and economically prosperous province in China.

Reports and Comments

The Central Area of Chicago--A Re-examination of the Process of Decentralization

THE purpose of this study was to determine the nature and extent of industrial movement within the central area of a metropolitan city—Chicago. It is part of a larger investigation which attempts to describe and analyze the changes in the spatial distribution of manufacturing establishments in Chicago and the Chicago Metropolitan Area.[1] The factor of population distribution was considered to be an essential part of such an investigation and was therefore included in the research.

The location of manufacturing units, an integral part of the urban complex, influences the distribution of other urban phenomena. For example, the distribution of residential development in a community may be affected by the distribution of manufacturing units in the area.[2] The invasion by industry of residential areas in the city is also a part of this picture. It is important, then, to know where, in what numbers, and what type of industry has moved into or out of the city.

Sociologists, human ecologists, city planners and others have long been interested in the problems of decentralization in our cities, particularly as applied to population. By decentralization I mean a decline in density in the central areas and an increase in density in the outer areas and suburbs of cities.[3] Industrial decentralization has only recently received the attention of sociologists, although they have recognized its importance in textbooks and elsewhere. There has been much speculative writing about the process of industrial decentralization, but there has been little or no research to measure the extent of this movement in any particular city.[4] In fact, there has been no research, to the best of my knowledge, that indicates whether and to what extent there has actually been any decentralization in our cities.

There has been a revived interest in the problems of the spatial distribution of industry since the beginning of World War II. The development of modern methods of warfare makes it possible for long-range aircraft and rockets to threaten any part of the earth. The literature urging decentralization and dispersion of population and industry are, in part, a reflection of the atomic age and world conditions. This study, therefore, has obvious implications in terms of national security.

As previously stated, this paper is concerned only with the changes in the distribution of industry in the central part of Chicago. Such activity is represented by movement away from and to the central area or Inner Zone, and by the advent of new industry in this part of the city. The changes in the distribution of population in the Inner Zone also are examined in this paper.

Technique and Methods

Brief statements of the techniques and methods used to collect and classify the data for this paper are necessary before turning to the analysis of the problem. This study did not use census data for information about industrial decentralization because there is only a limited use for these data. They reveal nothing, for example, about plant relocations.

[1] Leo G. Reeder, "Trends in the Location of Industry in the Chicago Metropolitan Area With Special Reference to Population." Unpublished Ph.D. dissertation, Department of Sociology, University of Chicago: 1952.

[2] National Resources Committee, *Our Cities: Their Role In the National Economy* (Washington, D C.: U. S. Government Printing Office, 1937); Maurice R. Davie, "The Pattern of Urban Growth," *Studies in the Science of Society*, G. P. Murdock, ed. (New Haven: Yale University Press, 1937); Noel P. Gist and L. A Halbert, *Urban Society*, (New York: Thomas Y. Crowell Company, 1950).

[3] This is similar to the definition of "deconcentration" in Robert E Dickinson, *City Region and Regionalism* (London: Kegar, French, Trubner, and Co., Ltd., 1947), p. 97.

[4] The only studies similar to this one are: *Regional Survey of New York and Its Environs* (New York: 1927), and the study sponsored by the New York State legislature, *Report of the New York State Joint Legislative Committee on Industrial and Labor Conditions*, No 51, 1941 and No. 47, 1942.

The period 1940 through 1950 was selected for analysis because data for the city of Chicago were available only for this period. The major sources of data for the investigation of industrial decentralization were: (1) the annual reports of the industrial divisions of the public utility companies,[5] and (2) the monthly reports of the industrial division of the Association of Commerce and Industry of Chicago. These available data were checked and supplemented by field studies, questionnaire surveys, and a kind of participant observation while gathering the data at the utility companies.

A system of sectors and zones was established for the city; these sectors and zones generally followed the boundary lines of groups of community areas—so-called natural areas. The data were analyzed for the distributional characteristics by reference to these sectors. The Outer Zone sectors of the city were extensions of the Inner Zone sector lines.

Social Characteristics of the Inner Zone

Of particular importance for our purpose is a brief description of the Inner Zone. The Inner Zone includes the central business district or the "Loop," and a large belt of wholesale, manufacturing, retailing, and residential areas. Physically, the Inner Zone is the oldest residential part of the city which is still available for residential use. This is the area in an advanced stage of obsolescence and deterioration—characterized by "blight." It is the locus of the slums and disproportionate social disorganization. Over the years the Inner Zone has been inhabited by successive waves of nationality and racial groups. The unflattering term of "stagnation" zone is used by one writer to replace the older ecological terms of "transition" or "conversion" zone, in describing the actual present-day scene. Mayer's and Breen's studies of the socio-economic areas of Chicago clearly indicate that the Inner Zone is composed primarily of people in the lower socio-economic class structure.[6]

In terms of the number of manufacturing establishments, the Inner Zone has at least a third more establishments than the rest of the city, but only slightly more workers are employed in these plants than in the Outer Zone.[7]

Major Findings

The location and movement of industry in the Inner Zone was examined by dividing the ten-year period of the study into two five-year periods, 1941-45 and 1946-50. The division enables the observer to see what has happened in industrial location during the war and post-war periods. To reflect and evaluate the trends of industrial location, three factors were used: (1) number of employees, (2) number of establishments, and (3) type of industry.

Industrial Movement to Places in the Metropolitan Area, 1941-45. The Inner Zone lost only 19 establishments to other places in the Chicago Metropolitan Area. Most of the plants that moved during this period employed less than 100 workers; none of them employed 500 or more workers. However, the plant employing less than 100 workers accounted for less than a third of the total number of workers employed by all of the plants that moved. The leading industry groups, in terms of the number of establishments, that moved in this period were fabricated metal products and chemical and allied products. By ranking the industry groups according to the number of employees in each group, it is possible to determine the dominant groups among the plants that moved. Such a ranking showed that the fabricated metal products group and the machinery group ranked first and second, respectively.

Industrial Movement to Places in the Metropolitan Area, 1946-50. The data revealed marked differences between the 1941-45 and 1946-50 periods. The stepped-up pace of industrial expansion and movement in this period made it simpler to detect patterns in the location of industry and patterns in the kind of industry. For example, 120 establishments moved to places outside of Chicago in the Metropolitan

[5] The public utility companies are Commonwealth Edison Company and Public Service Company of Northern Illinois.

[6] Albert Mayer, "A Method for Determining Socio-Economic Areas in Census Tract Cities," unpublished M.A. thesis, University of Chicago: 1948, and Leonard Z. Breen, "Separation of Place of Work from Place of Residence," unpublished M.A. thesis, University of Chicago, 1950.

[7] The Outer Zone contained 2,912 manufacturing establishments and 302,667 employees engaged in manufacturing; the Inner Zone contained 4,067 manufacturing establishments and 305,139 employees engaged in manufacturing. These data are taken from an unpublished study by the Chicago Plan Commission, 1951.

Area compared to the 19 that moved in the 1941-45 period.

Examination of the data showed that most of the establishments that moved in this period also employed less than one hundred workers. However, these plants again accounted for less than a third of the total number of workers employed by the plants that moved. In fact, seven establishments accounted for almost half of the total number of workers.

The fabricated metal products and chemical groups again ranked first and second, respectively, in the number of establishments. Ranking the industry groups according to the number of workers employed showed that (1) fabricated metal products, (2) machinery and (3) electric machinery and equipment groups led the other industry groups.

The West Side of the Inner Zone, called Sector 3, had the greatest loss of industrial establishments through movement to the Metropolitan Area. The Near South Side ranked second in the loss of establishments. It should be noted that Sector 3 contains more than 59 percent and Sector 5 contains only 7 percent of the industrial establishments in the Inner Zone. Proportionately, therefore, the loss was much greater for the South Side sector.

TABLE I—MOVEMENT FROM THE INNER ZONE OF CHICAGO TO THE METROPOLITAN AREA: 1941-50

Type of Industry	*Percentage Distribution of Establishments*
Fabricated Metal Products	23
Chemical and Allied Products	14
Machinery	10
	Percentage Distribution of Employees in Each Group
Fabricated Metal Products	23
Machinery	19
Electric Machinery and Equipment	12
Professional, Scientific and Related Products	9
Paper and Allied Products	9
Chemical Products	6
Food Products	6
Other	16
Employee Size Groups	
10-19	26
20-49	29
50-99	19
100-249	14
250-499	7
500-999	4
1000-2499	1

The Destination of Establishments That Moved From the Inner Zone. About 80 percent of the establishments that moved from the Inner Zone to the Metropolitan Area outside the city located adjacent to the city. There was a tendency for the establishments that moved from the central area to settle in sectors in the Metropolitan Area that corresponded to the sector numbers of their former locations in the city. For example, establishments formerly located in the near west side tended to move to the western suburbs and plants formerly located in northwest side of the city tended to move to the northwest suburbs.

About 61 percent of the establishments that moved from the Inner Zone to other locations in the city settled in the north and northwest sectors of the city. None of the plants that left the central area moved to the southwest side of the city and only a handful located in the southeast portion of the city. In fact, only 7.3 percent of the plants that moved from the central area to the Outer Zone, located south of 51st street and east of State Street. This is all the more significant when placed against the fact that about 80 percent of the vacant land available for industrial development was in this area.

Movement From the Inner Zone to the Outer Zone of Chicago. The examination of changes in the spatial distribution of industry would not be complete without including the movement of industries from one part of the city to another. There is much more of this type of movement than is generally supposed and the literature contains little, if any, reference to this phenomenon of industrial location. The Inner Zone of the city lost 42 establishments through intra-city movement in the 1941-45 period. On the other hand, only four establishments entered the Inner Zone from the Outer Zone of the city. No data were available on the number of employees of these plants. The fabricated metal products, machinery, and electric machinery and equipment groups dominated the types of industry that left the Inner Zone.

A total of 67 establishments moved from the Inner Zone to the Outer Zone in the 1946-50 period. Only eight establishments from the Outer Zone moved into the Inner Zone in the same period. The leading industrial groups that moved during this period were fabricated metal products,

chemical and allied products and machinery.

Sectors 3 and 5 again ranked first and second, respectively, in the loss of establishments in the ten-year period.

New Establishments In the Inner Zone, 1941-45. To effectively evaluate the trend of industrial location and the problem of decentralization, it is necessary to know how many new establishments entered the central area, as well as to know how many have left it in a given period. The Inner Zone gained 54 new plants in this period. Unfortunately, no data were available on the number of workers employed by these establishments in the 1941-45 period. The fabricated metal products and machinery groups led in terms of the number of establishments that entered the Inner Zone.

New Establishments In the Inner Zone, 1946-50. A total of 70 plants settled in this part of the city in this period. Almost half of the new establishments were in the smallest size category, 10-19 employees; on the other hand less than a third of the plants that moved from the city were in this size category. The leading industry group in terms of employment was the electric machinery and equipment group.

TABLE II—Movement from the Inner zone to the Outer Zone of Chicago: 1941-50

Type of Industry	*Percentage Distribution of Employees in Each Group*
Fabricated Metal Products	28
Machinery	12
Chemical and Allied Products	9
Electrical Machinery and Equipment	8
Food and Kindred Products	6
Others	37

Population Changes in the Inner Zone. Analysis of the population data by zones in the city revealed a reversal of a forty-year trend in the distribution of population in Chicago.

TABLE IV—New Establishments in the Inner Zone: 1941-1950

Type of Industry	*Percentage Distribution of Establishments*
Fabricated Metal Products	16
Electric Machinery and Equipment	11
Chemical and Allied Products	8
Food and Kindred Products	7
Machinery	6
Others	52

Type of Industry	*Percentage Distribution of Employment*
Communications (Electronics)	46
Electric Machinery and Equipment	12
Textile Mill Products	7
Chemical and Allied Products	7
Paper and Allied Products	5
Food and Kindred Products	4

Employee Size Group	*Percentage Distribution of Employees in Each Size Group*
10-19	50
20-49	24
50-99	10
100-249	14
250-499	0.5
1000-2499	0.5

The Inner Zone of the city had been losing population but in the 1940-50 decennial period, it gained population and, in fact, had a slightly higher percentage gain than the Outer Zone. Most of the gain occurred in

TABLE III—Increase or Decrease of Manufacturing Establishments in the Inner Zone of Chicago: 1941-1950.

Sectors	Number Moving Out				Out Total	Per Cent	Number Moving In				In Total	Per Cent	Net Change
	[a]	[b]	[c]	[d]			[a']	[b']	[c]	[d]			
I	1	22	4	10	37	14.9	10	7	1	2	20	14.7	—17
II	2	20	4	7	33	13.3	11	7	1	2	21	15.5	—12
III	11	53	18	26	108	43.6	22	19	..	2	43	31.6	—65
IV	1	3	5	3	12	4.8	7	10	1	2	20	14.7	— 8
V	4	22	11	21	58	23.4	20	11	1	..	32	23.5	—26
Totals	19	120	42	67	248	(100)	70	54	4	8	136	(100)	—112

[a] *Source:* Former locations of establishments that moved to metropolitan area locations, 1941-1945.
[b] *Source:* Former locations of establishments that moved to metropolitan area locations, 1946-1950.
[c] *Source:* Intra-City Movement of establishments, 1941-1945.
[d] *Source:* Intra-City Movement of establishments, 1946-1950.
[a'] *Source:* New Establishments in the Inner Zone, 1946-1950.
[b'] *Source:* New Establishments in the Inner Zone, 1941-1945.

Sectors 5 and 3, both of these sectors have large concentrations of Negro population.

The parts of the city were compared in terms of population and industrial changes for the 1940-50 period. A relative ranking of the sectors on these phenomena was made. Applying the Spearman formula to this ranking yielded a coefficient of -0.90; only one sector had equal rank on both items.

Conclusions

The data shows that the Inner Zone experienced a decentralization of industrial establishments. The difference between the number of establishments that moved out and the number that moved in accounted for a net loss of 112 industrial establishments. It should be observed that decentralization could hardly be said to have occurred unless the movement of plants within the city is taken into account. Otherwise, the difference between the plants that left the city and the new plants would be only 15 establishments. It is important to note that the city as a whole did not experience decentralization. The Outer Zone, as a matter of fact, gained industry. It is misleading, therefore, to make generalizations regarding the decentralization of industry from our cities without qualifications based upon facts as to the extent of industrial relocation. We need to distinguish between decentralization and growth of industry at the periphery of our cities.

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Tax Limitation in Ohio

MANY municipalities in the United States have found themselves in a fiscal straight jacket in recent years. Relying for 65 percent to 70 percent of their revenue on the general property tax, faced by rapidly increasing costs of government, limited by self-imposed tax limitation laws, most cities are desperately in need of new revenue. Because of tax limitation laws, many cities have been unable to increase their property tax rates and are rapidly turning to substitute taxes. In view of these facts, tax limitation laws should be re-examined in light of the economic and social developments of recent decades.

During the depression of the '30's there was a widespread movement in the United States to place a top over-all limit on property tax rates. Nine states today have these over-all limits. Four states—Nevada, Oklahoma, Ohio, and Rhode Island—had tax limits before the depression, although the Ohio and Oklahoma plans were revised after 1930. Indiana, Michigan, New Mexico, Washington and West Virginia enacted constitutional or statutory measures in 1932 and 1933. Since 1933 no state has adopted over-all limitations, but proposals were defeated in New York, New Jersey, Pennsylvania, Illinois, Wisconsin, Colorado, Oregon and Georgia.

History of Tax Limitation in Ohio

Ohio was the first state to impose an over-all tax limitation. As early as 1831 there was a sliding scale of tax limitation for specified purposes in counties and townships.[1] However, before 1911 the rates were so high as to make the practical effects of limitation negligible.

The first one-percent tax limit act was passed in 1910 and became effective January 1, 1911. Because the limitation provisions were not entirely clear, the act was amended in 1911. This law was known as the Smith law and gave Ohio "the most rigid as well as the most enforceable tax limit legislation to be found in any commonwealth."[2]

This law imposed a rigid ten-mill limitation, but permitted a levy of five mills more by a popular vote. At the same time a thorough reappraisal act was passed. The joint operation of the two acts was intended to bring out more intangibles, with the incentive of the lower rate. The operation of the two laws failed to force maintenance of a high level of assessment and resulted in an alarming increase in the school and other local debts. It was very apparent that it was impossible to operate local government in Ohio under such a rigid tax limitation. Such limitations failed to take into account the variations in the taxable wealth of the communities and frequently disregarded variations in the financial requirements of differ-

[1] Act of March 14, 1831, *Acts of a General Nature*, 29th General Assembly, p. 258.

[2] Raymond C. Atkinson, *The Effects of Tax Limitation Upon Local Finances in Ohio, 1911 to 1922* (Cleveland: Published by Author, 1923), p. 9.

ent types of communities. Accordingly, the General Assembly from time to time enacted specific statutes authorizing the levying of taxes outside the 10-mill limit. At a later date the 10-mill limitation was increased to 15 mills, and the General Assembly continued to enact statutes permitting tax levies outside the statutory 15-mill limitation.

In 1929 the Ohio Constitution uniform rule was abolished to make way for the classified property tax. Demanded by real estate boards and the farmer, an amendment to the constitution was passed in the same year "freezing" the statutory tax limit at 15 mills. The affirmative vote for the amendment was 58.24 percent. So, for the first time in the history of the state, a constitutional over-all tax rate limitation was provided. Unless additional tax levies were submitted to the electors and approved by at least a majority of the electors of the taxing subdivision voting on such a proposition, no taxes could be levied outside the 15-mill limitation by act of the General Assembly or otherwise. Then, in 1933 in the throes of the great depression—again sponsored by city real estate boards and farmers—the constitutional over-all tax limitation law was reduced from 15 mills to 10 mills by a three to two vote.

Present Tax Limitation Law in Ohio

As stated above, the aggregate amount of taxes that may be levied on taxable property in any subdivision or any other taxing unit of the state cannot exceed in any one year 10 mills of each dollar of tax valuation except as specifically authorized.[3] A "subdivision" is defined as any county or school district, except the county school district, the municipal corporation or township. The 10-mill levy is allocated to the units of government within the county by the county budget commission. If any unit of government within the county wishes to levy a tax outside the 10-mill limitation, it is necessary to have a vote of the electors in that taxing jurisdiction. The following majorities of the electors voting are needed to levy a rate in excess of 10 mills: (1) For current expenses of schools or of municipal universities—a simple majority. (2) For any other school purpose—25 percent. (3) For any other purpose than for schools—60 percent. For example, Oxford village a subdivision of Butler County, will request a certain levy from the county budget commission. If the commission does not allocate a sufficient amount to Oxford to meet its expenditures within a 10-mill limit, the village must either reduce its expenditures or have a vote on an additional levy outside the 10-mill limit.

Prior to 1949, in order to levy a rate in excess of 10 mills for any purpose other than for schools, a 65-percent majority of the electors were required. One of the reasons why local governments were unable to support themselves was the difficulty of getting a 65-percent affirmative vote on propositions submitted to the electors. Studies made by the Department of Taxation of election returns for a period of years indicated that many tax and bond levies were approved by 60 percent to 64 per of the electors voting on the question or issue. Continued failure to secure the necessary 65-percent affirmative vote discouraged many taxing authorities from submitting levies and caused them to turn to the state or to substitute taxes for financial assistance. Through the years, however, with persistent effort most municipalities today have rates outside the 10-mill limit.

It is interesting to note that the affirmative vote for reduction of the limitation to 10 mills in the 1933 election was less than 60 percent of the total vote cast. Although the 65 percent majority was reduced to 55 percent in 1949,[4] logic supports a simple majority requirement if tax limitation is to be continued. If the tax limitation can be reduced to 10 mills by a majority of all the votes cast in the state, there is no valid reason why taxing districts should be denied the privilege of voting levies outside the 10-mill limitation when at least a majority of the electors are willing to maintain the taxing district on a pay-as-you-go-basis.

Evidence as to the Operation of Tax Limitation in Ohio

Many advantages of tax limitation laws have been advanced by the proponents of such legislation. Each of the advantages claimed will be tested here for validity under Ohio's experience.

Permanent Reduction of Property Taxes. The primary objective of a tax limitation law is to force a substantial reduction in property

[3] *Page's Ohio General Code, Annotated,* Section 5625-2.

[4] *Ibid.,* section 5625-18.

taxes. It is claimed that, by reducing the burden on real estate, limitation laws would force the states into broadening of the base of taxation. Thus, other forms of wealth would share with real estate on a more equitable basis, the cost of operating government.

The changes in the total property tax levies in Ohio are shown in Table I. As shown, there has been some reduction in total property tax levies. Whether this can be attributed wholly to rate limitation is problematical, but at least tax limitation has prevented any rise in property taxes.

One of the best methods of visualizing the effect of the tax limitation on property taxes is by a comparison of per capita property tax collections of Ohio with those of other states. In Ohio the per capita property tax receipts for state and local governments declined 25 percent from 1932 to 1942 while the reduction for the United States as a whole for the same period was only one percent with 22 states showing an increase. In the nine states with over-all property tax limitation laws, the average reduction in per capita property taxes collected was 17 percent compared to the average of the nation as a whole of one percent.[5]

TABLE I—Total Property Tax Levies In Ohio, 1931-46

(Including Special Assessments)

Year	*Total Levy*
1931	$307,616,505
1932	279,829,426
1933	260,304,788
1934	236,087,301
1935	235,662,751
1936	234,372,167
1937	235,071,718
1938	229,455,161
1939	237,098,429
1940	239,713,898
1941	244,328,900
1942	250,470,227
1943	250,816,939
1944	254,700,625
1945	255,787,875
1946	283,025,052

Source: Annual Report of the Department of Taxation, State of Ohio (1947), p. 34.

[5] Bureau of Census, *Governmental Finances in the United States: 1942.*

Although the reductions in property tax receipts in tax limitation states cannot be attributed entirely to the operation of the tax rate limits, the above data substantiate the claim of the proponents of the law that tax limitation results in a substantial reduction of property taxes. Further, it cannot be said that the total effect of this reduction has been beneficial. The fixing of rigid rate limits has produced many concomitant objectionable results which will be discussed later.

Reduction of Public Expenditures. The proponents of tax limitation claim that by reducing the revenue of government, a reduction in public expenditures will result. This reduction would be accomplished without harmful effects through greater efficiency and economy in government and the elimination of unnecessary services.

A study of the expenditures of the state of Ohio shows a rapid increase since 1931. Total state expenditures, including capital outlays and debt retirement, amounted to $77 million in 1931, $123 million in 1942, and $592 million in 1950. The rate of increase for the state of Ohio from 1931 to 1950 was 669 percent while for the nation as a whole the rate of increase was only 426 percent. For the nine tax-limitation states, the percent of increase in state expenditures was 570 percent over the same period. The per capita expenditures of the state of Ohio increased 642 percent from 1931 to 1950 while for the United States the increase was only 440 percent. It is interesting to note, however, that the per capita expenditures in 1950 in Ohio are still below the national average, $74.02 compared to $89.24.[6]

This steady increase in the annual expenditures was due mainly to the transfer of functional and financial responsibilities from local units to the state. Although nation-wide in scope, this centralizing trend was probably strongly stimulated in Ohio by the existence of tax limitations. The state, since 1932, has assumed greater responsibility for welfare, particularly aid for the aged and poor relief. Again, there was increased financial participation by the state in public education and highways.

In contrast with its ineffectiveness in limiting state expenditures, tax limitation appears to have had a restrictive effect on the current

[6] Bureau of Census, *Financial Statistics of States and Local Governments; 1932; Compendium of State Government Finances in 1950; Governmental Finances in the United States: 1942; Compendium of City Government Finances in 1949.*

expenditures and capital outlays of municipalities. Expenditures of municipalities in Ohio were $172 million in 1931, $109 million in 1942, and $129 in 1949. Although this decrease in expenditures was general throughout the United States, there was a larger decrease in Ohio and the other tax limitation states. From 1931 to 1942 municipal expenditures in the United States declined on the average of 25.4 percent while in Ohio this decline was 36.7 percent and for the nine states with over-all limitations, 30.1 percent.[7]

In absolute amounts, municipal expenditures have increased in Ohio since 1935. This increase, however, has not been sufficiently large to compensate for higher prices and to provide for the growing needs of municipalities.

Full-value Assessment of Real Estate. Again, the sponsors of tax limitation contend that the imposition of an over-all rate limitation would serve as a stimulus for full-value assessments. Because general under-assessment of property is the rule in most states, the reduction in revenue caused by a tax rate limitation could be supplanted substantially by a higher average assessment ratio. Furthermore, the raising of all assessments to a full-value level would result in more equitable property taxation by reducing inequalities in ratios of assessed to true value.

Contrary to this expectation, tax limitation laws have not only failed to increase the ratio of assessed to true value but also failed to prevent a large reduction in the average ratio of assessments. In a study in 1925 by Professor Moore,[8] the average ratio of assessment in Ohio was 85.95 percent of the sales price. A similar study was made by this writer after the reappraisement of 1949-1950. Ten counties were selected, five of which were predominantly rural and five preponderantly urban. A sample of 2,020 sales of property was compared with the assessed value of the properties. The average assessment ratio was only 46.5 percent compared to 85.95 percent in 1925. The ratios were found to range from less than 20 percent to over 170 percent. The average deviation for the sample of 2,020 properties was 10.9 percent and the coefficient of dispersion was 23.44 percent. This shows that the assessment of property in Ohio has not improved much in relation to uniformity of appraisal in twenty-five years. The coefficient of dispersion is a comparison of relative magnitudes and is found by computing deviations from the average assessment ratio. The average deviation is divided by the average assessment ratio to get the coefficient of dispersion. A margin of 10 percent is usually allowed for imperfections in the data. The coefficient of dispersion for Ohio of 23.44 percent is cause for concern.

In fact it might be contended that, instead of forcing full-value assessments, tax limitation has helped to prevent such increases. Most local taxing districts in Ohio levy the maximum rates allowed. Because property owners and assessors realize that increased valuation would undoubtedly be accompanied by an automatic increase in property taxes, governmental officials turn to other revenue sources for meeting any additional needs.

Increased Use of Alternative Tax Sources. It is claimed that tax limitation would force a broadening of the base of taxation. Thus, other forms of wealth would share with real estate on a more equitable basis, the cost of operating government.

It is true that tax limitation in Ohio has resulted in the increased use of alternative sources of revenue in Ohio. The trend toward indirect taxes shows an acceleration coincidental with the limitation. The burden of direct taxes has dropped from 67.9 percent in 1934 to 52.4 percent in 1938 to 43.6 percent in 1948. The chief increase in indirect taxes is attributable to the enactment of the sales tax in Ohio in 1935.

A study of strictly local revenue sources shows an increase in the so-called nuisance taxes. Fees, charges for services and minor sales, licenses, and permits, fines and forfeitures, parking meter revenues, and miscellaneous classification have increased. Of note is the increase in the number of cities levying a city income tax. Seven cities in Ohio—Toledo, Columbus, Dayton, Springfield, Warren, Portsmouth, and Youngstown—have tried a city income tax. Cincinnati has used the city income tax as a threat to get a property tax rate outside the 10-mill limit approved by the electors. Whether this trend is desirable will be discussed subsequently.

[7] *Ibid.*

[8] H. R. Moore, *Taxation as Related to the Property and Income of Ohio Farms* Ohio Agricultural Experiment Station Bulletin 459 (Wooster: Sept. 1930) pp. 34-38.

Reduction of Tax Delinquency. Supporters of tax limitation argue further that such laws, by reducing the tax bills of property owners, would greatly diminish the number of delinquencies. Although delinquency has been greatly reduced in Ohio since 1934, it cannot be fully ascribed to the tax limitation laws. A more logical explanation lies in the recovery from the depression of the thirties. How much of this reduction in delinquency, if any, is the responsibility of tax limitation cannot be determined.

Reform of Local Governmental Structures and Administration. It is claimed that tax limitation laws would force much needed reforms in local government by reducing property tax revenue. If there has been any effect at all, the limitation amendment has added impetus to the consolidation of school districts in Ohio.

Most local governments have either expanded other sources of revenue or curtailed the services performed in order to continue to operate. Professor Emch has described the situation resulting from the operation of tax limitation as follows:[9]

"Some of the operating expedients found necessary in the fourth decade of this century would properly be a subject for a treatise on how cities should not be operated. Probably the most drastic of the operating expedients was the closing of the public schools in Cincinnati in 1937, in Dayton in 1938, and in Toledo in 1939, among others, and the the relief shut-downs in Cleveland and Toledo in 1939."

On the other hand, many objections have been raised against property tax limitation laws.

Creation of a Regressive System of Taxation. The opponents of tax limitation claim that such laws encourage the transfer of local functions and financial responsibilities to the state. Faced with a growing need for revenue, the state must rely increasingly on substitute taxes, which usually take the form of sales taxes. These taxes are claimed to be less in accord with the ability to pay concept than the property taxes which they have supplanted. Such is the case in Ohio. In 1950, Ohio received 53.7 percent of her revenue from sales and gross receipts taxes enacted for the most part after the ratification of the 10-mill limitation. Although Ohio exempts food from the retail sales tax, it is contended that the tax system of the state is as regressive, if not more regressive than before the enactment of the sales tax.

On the local level, it is further contended that the enactment of a city income tax in seven cities has also tended to make the tax system more regressive. This tax applys only to salaries, wages, and earnings of business and professions, has no personal exemptions, and uses a proportional rate. As a result, this tax as levied in Ohio disregards much ability to pay, penalizes earned income and is regressive in effect. Thus, another regressive tax is added to Ohio's tax system.

Further, in most cities there has been an expansion of special service charges. These have many forms: charges for sewage disposal, street lighting, fire protection, parking etc. Because of the maxim that it is more convenient to pay a comprehensive tax than to pay a great number of petty ones, it is doubtful if such charges have improved the local revenue systems of Ohio.

Curtailment of Vital Services. There is abundant evidence which demonstrates that municipal services have been curtailed by the combination of property tax limitations and growing governmental costs. At hearings conducted by the Tax Commissioner relative to the financial needs of local governments in 1947, the League of Ohio Municipalities testified:[10]

"Ohio municipalities face serious operating deficits in the 1947-48 Biennium. Prices of materials, wages, salaries, and the cost of living have increased sharply. The necessity of restoring adequate public service and protection requires that reduced municipal personnel be restored to pre-war standards. Maintenance of property and equipment, deferred during the war years, is essential to protect the public capital investment and provide efficient service. Supplementary wage and salary increases must be made to secure and retain essential personnel. Additional revenues must be provided to pay for the several increases in mandatory requirements on local governments."

"Local tax levies and other sources of local income are insufficient to meet these additional costs. Cities, villages, counties, and townships face operating deficits in 1947 in excess of $50,000,000. Substantial state assistance to local governments

[9] Donovan F. Emch, "The Effects of Tax Limitation in Ohio," *Property Taxes* (New York: Tax Policy League, Inc., 1940), p. 66.

[10] State of Ohio Department of Taxation, *A Study of the Tax and Revenue Systems of the State of Ohio and its Political Subdivisions* (Columbus: 1947), p. 75.

from state levied and collected taxes is essential for 1947-1948."

This situation still exists in many municipalities. Most, however, have improved their financial position by the adoption of substitute taxes or increased their property tax levy further outside the 10-mill limit which in turn defeated entirely the purpose of the tax limit.

Tax-Limitation Laws Create Inflexible Local Revenue Systems. Tax limitation laws have been criticized on the ground that they have added another inflexible element to the local revenue systems. In the first place, the rigid rate limitations fail to make adequate allowances for possible increases in the financial requirements of local governments. Second, such laws fail to take into account varying conditions among local governments, ignoring completely the fact that the needs of municipalities and the desires of people for services are not the same. Such differences as geographical location, industry and trade, residential construction, and others, may result in widely differing financial requirements for such functions as streets, sewers, recreation, public health, and public safety. Moreover, where needs are similar, municipalities may differ markedly in the kind and amount of taxable wealth within their boundaries.

Much of the weight of this argument has been reduced by the ability of many cities to expand their revenues by substitute taxes and by the flexibility of state aid.

Undermining the Credit of Local Governments. A frequent criticism of property tax limitation is the claim that such limits undermine the credit of local governments. Although debts grew alarmingly in some local governments in the earlier years of tax limitation, effective debt limitation has resulted in a decrease in local debts in Ohio.

The State Legislature controls the amount of debt that municipalities may incur. They have laid down two general rules as follows: (1) no municipal corporation may incur debts of more than one-percent of the assessed valuation of the taxable property located within the municipality without the approval of the electors; (2) with the approval of the electors a municipality may incur debt not to exceed five percent of the asssessed valuation of taxable property within the municipality. Because the Legislature has exempted several types of bonds from the above limitation, several cities have incurred debts of more than five-percent of the assessed valuation of taxable property within the municipality.

The gross debt of cities in Ohio was $393 million in 1933; $347 million in 1943, and $365 million in 1949. Nationally, the gross local debt increased slightly over one-percent between 1932 and 1949, while in Ohio during the same period the municipal debt was reduced by seven-percent.[11] This indicated that the combination of tax limitation and debt limitation has not undermined the credit of local governments in Ohio. It may also indicate a failure to provide adequate services or to carry out long range capital improvement programs.

Loss of Home Rule. Another criticism of property tax limitation is that it leads to increased centralization of governmental authority at the state level, thereby reducing local control of government. This criticism is based on the point of view that local governments are closer to the people than state government, and therefore, should be more responsive to their needs and desires. It is claimed that active participation in the determination of the local budget is necessary to good local government and that home rule is impossible under the provisions of tax limitation amendments. Much difference of opinion exists among authorities in the fields of political science and public finance as to the most suitable division of many functions between the states and their local subdivisions. Those who support "home rule" are also opposed to tax limitation laws.

Conclusions

The restriction of public expenditures and the relief of real estate by property tax reform were among the important reasons for the adoption of tax limitation in Ohio. It is true that the payment of real estate taxes during the greatest depression imposed a heavy burden. It is true that a drastic reduction in the relative level and importance of property taxes has been brought about by the operation of tax limitation. It is doubtful, however, if the broadening of the tax base has created a more equitable system of state and local taxation. Although the property tax is regressive in many cases, the substitution of the sales tax and city income taxes in Ohio has added to this regressivity. To call the

[11] State of Ohio, Auditor of State, *Comparative Statistics, Cities of Ohio* (Columbus: 1933, 1943, 1949); Bureau of Census, *Government Debt in 1949.*

substitution of these taxes for part of the property tax a tax reform is a doubtful application of the term. Constructive tax reform is more likely to result from positive legislative action than from an indirect method of forcing changes in the tax structure by limiting property tax rates.

It is also important to note that much of the property tax is capitalized and consequently the reduction in property taxes achieved served only as an unearned increment to owners of property when the reduction took place. Future owners received little relief. Further, real estate owners are at present well able to pay full rates of property taxation so that the very acceptance of the argument by which over-all tax limitations came into existence implies that they should now be removed.

Further the operation of the tax limitation law in Ohio has reduced most local governments to the state of "humble mendicants seeking succor at the hands of the state." In many instances it has hampered the performance of vital municipal services. There is, however, justification for some restriction on the finances of local governments, but the proper place for restriction is on expenditures, not on taxation. To restrict taxes on real estate is not to counteract their proper cause, expenditures. Limitation on expenditures also brings taxes into the restriction. What a local unit ought to spend cannot be isolated from its means of payment. Many writers in the field of public finance advocate the control of local expenditures by a state board. This would allow sufficient flexibility to meet the varying financial requirements of local government but may be open to many of the same objections raised against tax limits.

Because the constructive changes brought about by the tax limitation law in Ohio have been outweighed by the objectionable effects which have accompanied them, it appears that the reform of the property tax and local revenue and expenditure systems must be accomplished by some other means than property tax limitation.

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The Forecasting of Population by Census Tracts in an Urban Area

MANY functions of municipal and economic planning involve an attempt at forecasting the population of an urban area in detail, in order to determine the direction and intensity of the city's growth. Municipal planning boards, utilities, retail chains, and other governmental, commerical and social agencies may feel the need for planning the location of capital improvements, facilities, and outlets many years in advance, and are in need of information on the growth pattern of the community by political subdivisions or other small units.

In cities of fast growth where the rate of expansion is rapid and the direction of growth trends uncertain, the problem of forecasting the future city pattern is of particular importance. While it may be desirable to obtain an accurate picture of the exact size of the population at the end of the forecast period, it may be even more important to determine where the population will be. To illustrate: For a municipal planning board it is less important to determine whether the city population will reach a certain size 20 to 25 years ahead than it is of interest to know where municipal improvements will become necessary at the time when this growth will be reached.

A great weakness in the forecasting methods used in common planning practice is the indefiniteness of the area concept. Forecasts are usually undertaken for the territory covered by the present municipal confines of the locality. Population trends, however, are not confined by political boundary lines but tend to follow the economic pattern of the area. A population forecast made by the road department of a city for the future population of the city may have little significance if most of the growth occurs outside the city limits and affects the suburban and rural road system of the county. The history of our metropolitan districts shows many examples of the integration of outlying districts into the area and the amalgamation of neighboring districts into one economic area. A population forecast is less likely to fall short of the goal of realism

and accuracy if it embodies area-thinking into the frame of its municipal concept.

A great improvement of the tools of area forecasting is supplied by the census tract system. Since boundary lines of tracts are permanently fixed, historical data for the growth of individual tracts have become available or—for the newly-tracted areas—will be developed in the future. In the untracted cities, a far more complicated procedure for tracing the area growth imposes itself.

An attempt at forecasting the growth pattern of a rapidly expanding metropolitan area was made in the standard metropolitan district of Miami. The forecast area has grown within 50 years from virtually nothing to an urban area of approximately one half a million people. An average growth of 7 percent per annum was maintained over a 25-year period and supports the assumption that the area will reach a population of one million somewhere between 1960 and 1965. In the area forecast, the question of when the million mark will be reached was left open. Although it was realized that the growth pattern itself would be influenced by the rate of growth at various phases of the forecast period, it was believed that this problem was secondary to the one of determining the direction of the area expansion. The forecast problem was therefore circumscribed as the task of determining the probable distribution of a one million population over the forecast area. The metropolitan district of Miami, which is identical with Dade County, Florida, was chosen as a forecast area. It covers 2,000 square miles of which only 300 square miles are potential habitats, the rest being swampland. The area has enough room for expansion to exclude the probability of spilling over into the adjacent counties during the forecast period.

For purposes of the forecast, the area was divided into its 80 census tracts and 11 untracted areas. For each of the 91 subdivisions, the population development was traced back to 1930.[1] The reconstitution of the historical picture was aided by enumeration district data supplied by the U. S. Census of 1930. Since those data existed only for the city of Miami, estimates had to be made for the outlying districts according to figures that were contained partly in census data on city populations of suburbs and partly from figures on voting precincts. Since in 1930 the major population of the area was within municipal border lines and only 10 percent in the unincorporated areas, the probable error of estimate was minor. The Geography Department of the University of Miami provided data on the area of each census tract, thus making it possible to estimate the population density in each tract for 1930.

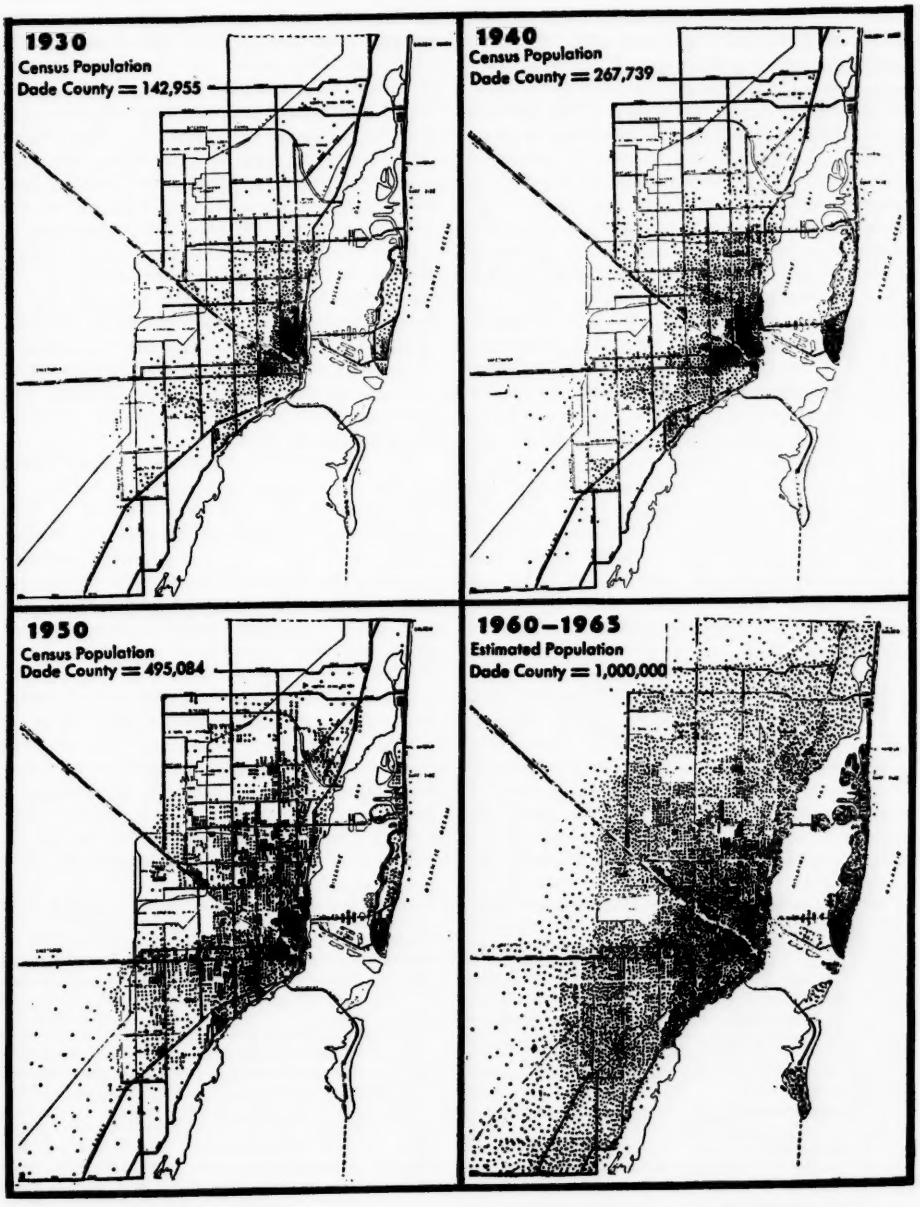
In approximately the same manner the picture of the 1940 distribution of population was reconstituted. Voting precinct data available from the census provided a fair basis for the estimates. In the inner parts of the cities more detailed data were available through counts of enumeration districts. It was also possible to reconstruct the demographic pattern of certain neighborhoods from extraneous materials such as old street maps, voting registrations and newspaper distribution data.

For 1950, detailed distribution data for 692 enumeration districts of the U. S. Census allowed for a fairly precise fixation of the population scatter in each census tract. Even in this case, field checks and extraneous materials had to be used to give the desired accuracy of the detail. After population densities for 1930, 1940, and 1950 for each tract area had been calculated, spot maps were drawn, see sections 1 to 3 on the map. For purposes of accuracy, the base map of the county was used in connection with an overlay containing the census tracts. For 1950, the accurate pattern of distribution was determined by maps on large scale traced from the Census Bureau's enumeration district maps and reduced by photostatic process to smaller size after the totals had been applied. Also for each census tract the percentage growth was determined. This way an historical growth picture of each census area was developed.

The forecast of individual tracts was accomplished in three steps: (1) The general direction and growth trend of the total Miami area was determined; (2) Quotas were assigned to sections of the city comprising several groups of tracts according to the expected growth trend of each section; and (3) Population quotas were distributed among the census tracts in each section according to

[1] Materials useful for reconstructing the history of city patterns are identified in Homer Hoyt's study: *The Structure and Growth of Residential Neighborhoods in American Cities* (Washington, D. C.: Federal Housing Administration, 1939), Part I, Chapter II.

Population Growth of the Greater Miami Area
(each dot equals 100 persons)



the density rates expected within these areas.[2]

The first step in this process, the determination of the general geographic growth trends, is by far the most important task in solving the forecasting problem. It involves the scrutiny of the topographical, economic, social, and other factors which determine the population growth trend in various communities. While a basic understanding of the theory of city growth is essential for the fixation of actual area trends, there is no need for the demographer to get lost in the maze of conflicting theories.[3] Regardless of whether he adheres to the theory that urban areas grow basically in a concentric manner or whether one follows the assumption that traffic patterns of axial highways are determining the spread of the population, there are generally enough practical considerations that provide guidance to the analyst.

In the instance of the city of Miami, it was clear at the onset that two major natural obstacles—the ocean to the east and the swamplands to the west—force a sock-like north-south expansion of the area.

The past demographic history of the area indicated that factors favoring growth into certain directions had balanced themselves with a result that little change in the population center had occurred. Regardless of whether we should ascribe this trend to the powerful influence of the centrifugal forces which the concentric circle theory assumes or whether we consider it merely as a result of coincidental factors of the given area, the fact remains that within the limitations of the topographic shape of the area, there was reason to assume that the growth of the area in the next 10 or 15 years would not basically upset the balance of the four sections—north, south, east and west—which in the past had fairly equally absorbed the growth increment. For this reason there could be fairly equal shares assigned to the northern and southern sectors of the area, while the eastern and western sectors were assigned slightly lesser quotas. The major task, however, was to determine how the population would distribute itself within these sectors. This involved an analysis of the density pattern from the center outward.

Generally, the population of an urban area shows the largest density ratios in the inner districts with densities petering out in fairly equal proportions toward the outskirts of the city. Most cities will have population clusters in various suburbs, on the one hand; and on the other hand, empty spaces, that interrupt the pattern and mock the attempt of statistical projection.

The history of population growth in Miami seemed to indicate that maximum densities will be lower than in other cities of a comparable size. Climatic reasons are mainly responsible for this. The near tropical climate, the flat topography, the permeable soil structure all encourage a loose pattern of settlement. So does the wide use of motor cars and the absence of a narrow street system in the downtown area.

Under these circumstances it was a relatively safe assumption that residential areas would grow where they are in shortest distance to the economic center of the area, but will also be guided by the desirability of avoiding overcrowded built-up areas. Following this general pattern, the region developed in a ring-shaped manner. In each

[2] The procedure here recommended follows basically the so-called ratio method of forecasting which consists in predicting the future population of a smaller area by a projection of ratios which the smaller area held in the larger area during various stages of its historical growth. However, because of the small size of the areas involved, it is possible to extrapolate ratios in a mathematical way. A critical evaluation of the ratio method will be found in Donald L. Foley and Gerald Breese, "Accuracy of the Ratio Method for Forecasting City Population," *Land Economics*, November 1951.

[3] In the discussion of these theories, two separate aspects have frequently been confused. The question of the structural composition of the city which gave rise to the concentric cycle theories of Burgess has been widely discussed in connection with the problem of the growth patterns. This is a distinct problem and one in which the prognosticator of the city ecology is most directly interested. E. W. Burgess in his original studies and later on in the modified applications presented reasons for concentric growth which he derived from the basic ring structure of the city. See E. W. Burgess, *The Growth of the City, Introduction to a Research Project*, Publication of the American Sociological Society, 1924 Volume XVIII, pages 85-97; also, R E. Park and E. W. Burgess, *The City, Chicago* (1925) Chapter II. Richard M. Hurd (in *Principles of City Land Values*, 1924, p. 39, ff.) held that the expansion of the city follows a star pattern, the growth being both central and axial. Homer Hoyt (see *The Structure and Growth of Residential Neighborhoods in American Cities*, p. 96. ff.) has been credited with the so-called sector theory. (See discussion of this theory by Lloyd Rodwin, "The Theory of Residential Growth of Structure," *Appraisal Journal*, July 1950, with further discussion in *Appraisal Journal*, October 1950, by Hoyt, p. 445 and Fiery, p. 451.) Hoyt (*loc. cit.*, p. 99), in discussing the growth of the city of Chicago, showed, however, with respect to the recent period of growth of that city, that all forms of growth appear simultaneously—vertical and interstitial expansion, axial and central growth, the expansion and coalescence of existing outer nuclei and the growth of new isolated nuclei on the fringe of the city. Miami is another example where all of these growth patterns can be observed.

period of growth the analysis of the past record revealed a new ring was added and growth within the older rings continued until maximum densities had been reached, whereupon the growth spilled over to the adjacent rings.

This basic pattern of growth is, however, subject to important exceptions. Large-scale employment opportunities regardless of location become in themselves magnets of population growth. In Miami the large resort activity in the center of Miami Beach and the employment opportunities provided in and around the airport in the northwest of the city provide typical examples for this type of crystallization. To a minor extent the retail shopping centers spreading up in various suburbs provided parallel focuses of population growth. The topography—dangerously low lands between the coastal ridge—and the location of highways and of causeways formed another important determinant of demographic growth.

Finally, the governmental pattern of zoning and planning regulations establishes man-made barriers to certain types of subdivisions and fosters others. In some of the residential areas, high zoning restrictions are established by local code to promote high-class residential developments and insure a loose pattern of settlement. In other areas the unwritten law of racial segregation contained vast portions of the colored population in dense clusters of settlement. The prognosticator of area trends has to determine the extent to which in various areas the man-made laws would hold under the pressure of forces that would press in opposite directions, either reducing or increasing the legally-imposed population density.

In the same direction arbitrary actions and municipal decisions such as the future location of main traffic arteries, the construction of causeways to and between islands, the location of facilities for air and surface transportation, the zoning for industries and similar municipal decisions could not fail to provide difficult problems for the ascertaining of the population ecology. They involve certain basic decisions as to the future economic pattern of the area; for instance, a determination of the probable pace of industrialization that in turn would influence the scatter of residential areas.

In forecasting population within heterogeneous groups of census tracts, a historical approach was followed. It was assumed that outer areas would tend to build up to present average densities of adjacent areas because that had been the trend in the past. For instance, the newly-developed fringe areas in the southwest of the city were assigned density ratios that the old southwest section had developed ten years earlier. The rural area on the outskirts of this fringe area was assigned the approximate density that the fringe urban area holds at present. The bench-mark figures thus obtained were then adjusted according to the particular features of each area according to the economic and topographical pattern. After this adjustment the section total of estimated population was broken down into the census tracts.

Basically the quota assigned to each tract was determined by its present population share. However, many exceptions were made. Individual features of each tract had to be taken into consideration. In estimating the future density of land uses, factors such as the expected growth of retail developments in the business sections, the availability of coherent vacant land, the topographic character of the tract and other factors were considered. The forecast proved particularly difficult for the non-tracted census areas at the outskirts. It was realized that subdivision activity in these areas was co-determined by merely accidental factors such as the ownership conditions, the site selection for industrial and commercial activities, the location of future highways, the location of military bases and similar factors which are now beyond the appraisal of the prognosticator. The probable error of the estimate increases, therefore, with the distance from the city center.

After the expected population for each census tract had been calculated, the population increase over 1950 was established and plotted on a dot map in a distinct color pattern. This pattern was studied and compared to the past growth pattern and adjustments were made where inconsistencies still seemed to exist. After elimination of these inconsistencies and re-adjustment of all figures, a dot map of the forecast population and its distribution for the forecast period of 1965 was drawn and population estimates, projected increases, and estimated densities were incorporated into the tabulation of each tract.

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A Landmark Zoning Case: Minimum Living Space Restrictions

IT has been implicit for years in state appellate court decisions that, given "appropriate facts," a zoning ordinance could validly prescribe minimum living space requirements for family dwellings. But, until the recent, highly-noteworthy decision by the New Jersey Supreme Court in *Lionshead Lake, Inc.* v. *Township of Wayne*,[1] state high courts had always, with one exception,[2] concluded that the particular facts before them were inappropriate to the validity of such an ordinance. The Lionshead case is also noteworthy because, taking the majority opinion and Justice Jacobs' concurring opinion together, there is presented what is, to date, by far and away the best judicial analysis of the validity of minimum living space requirements.

Lionshead Lake, Inc. had been constructing houses in Wayne Township, New Jersey, some of them with only 484 square feet of living space. Justice Jacobs in his concurring opinion aptly adapts Jonathan Swift's *Verses in Blenheim* to these "doll houses:"

"Thanks, sir, cried I, 'tis very fine,
But where d'ye sleep, or where d'ye dine?
I find, by all you have been telling,
That 'tis a house, but not a dwelling."

In 1949, after Lionshead had built 100 houses, the Township revised its zoning ordinance to require minimum living floor space as follows: 768 square feet for a one-story dwelling, 1000 square feet for a two-story dwelling with attached garage, and 1200 square feet for a two-story dwelling not having a garage attached. These requirements were made uniformly applicable to the whole township, which—though still rural in character—lies in the path of the next onward wave of suburban development. Only about 70% of all existing dwellings in the township met the minimum requirements of the ordinance and in some sections of the township as few as 20% of the dwellings conformed. To build a dwelling of the required minimum for year-round residence would cost, it was estimated, $8500 to $12,000.

Nevertheless, the ordinance was sustained against Lionshead's vigorous attack and the lower court's judgment was reversed. The majority opinion, written by the court's able Chief Justice Vanderbilt, pointed to amendments of the New Jersey constitution and of the state's zoning enabling act granting broad zoning powers to municipalities, including the power to fix minimum living space requirements. From this the court concluded that the township clearly had the power to adopt limitations of the type in question and held that the contestant had failed to sustain its burden of proof that the limitations were unreasonable or arbitrary. Instead, the court believed them reasonable first, for reasons of public health, and second, because they protected the general welfare of the community. The last is as close as the court came to a discussion of the protection of existing real estate values and the preservation of a fat property tax base as reasons for minimum living space standards.

The court's "respect" for the testimony of C.-E. A. Winslow, professor of public health at Yale University for the past thirty years, is shown in the following quotation in the court's opinion:

"Much of the proof adduced by the defendant township was devoted to showing that the mental and emotional health of its inhabitants depended on the proper size of their homes. We may take notice without formal proof that there are minimums in housing below which one may not go without risk of impairing the health of those who dwell therein. One does not need extensive experience in matrimonial causes to become aware of the adverse effect of overcrowding on the well-being of our most important institution, the home. Moreover, people who move into the country rightly expect more land, more living room, indoors and out, and more freedom in their scale of living than is generally possible in the

[1] 10 N. J. 165, 89 Atl. (2d) 693 (1952). For a complete discussion of living space requirements see, *Planning Advisory Service Information Report 37* (Chicago: American Society of Planning Officials, 1952).

[2] *Dundee Realty*, v. *Omaha*, 144, Neb. 448, 13 N. W. (2d) 634 (1941). For lower court holdings sustaining living space restrictions see, *Thompson* v. *Carollton*, 211 S. W. (2d) 970 (Tex. Civ. App. 1948) and *Flower Hill Bldg. Corp.* v. *Flower Hill*, 100 N. Y. S. (2d) 903 (N. Y. Sup. Ct. 1950.) See also, Robert McClory, "The Undersized House," *Chicago-Kent Law Review* 142, 1948.

city. City standards of housing are not adaptable to suburban areas and especially to the upbringing of children."

The concurring judge gives greater and more specific weight to public health considerations.

Undoubtedly, as a result of this case, public health considerations in the future will be used by municipal attorneys seeking to sustain living space limitations in building or housing codes or in zoning ordinances.

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Book Reviews

The Soviet Economy During the Plan Era. By Naum Jasny. California: Stanford University Press, 1951. pp. 93, $2.00: also, and by the same author, *The Soviet Price System*, 1951, pp. 156, $2.00; *Soviet Prices of Producers' Goods*, 1952, pp. 154, $2.00.

The author of these three works is well known for his work, *The Socialized Agriculture of the USSR*, a scholarly study of Soviet agricultural economy. These volumes deal with problems of both agriculture and other sources of national income, namely: industry, construction and trade.

In *The Soviet Economy During the Plan Era* Jasny defines precisely the terminology, "current prices" and "unchangeable 1926-27 prices," as officially used in the USSR for the indexes of industrial production, national income, real 1926-27 prices, and the Soviet concepts of national income. He reaches the significant conclusion, on the basis of available data, that the prewar USSR territory taken alone had an agricultural output in 1948 lower than in 1928. The output of industry *valued* by the Soviets at "unchangeable 1926-27 prices" persistently displayed increases in value output several times greater than the increases in output measured in physical terms. The book includes (p. 20) a table showing targets (goals) and degrees of fulfillment of the first Five Year Plan, especially in goods consumed by the population of the Soviet Union. All of the data are expressed in percentage increases. For example, in the first Five Year Plan an increase in cotton goods of 69% was projected. In reality, there was a drop of 2%; for woolen goods, instead of the projected 180% increase, there was a drop of 6%; for matches the target rise was 122%, and the actual rise was 2%; for soap the projected rise was 176%, the accomplished rise was 64%. The third Five Year Plan period (1937-40) also showed great differences in targets and the degree of fulfillment: steel was projected at plus 20% and fulfilled 3.5%; rolled steel projected at 31% increase and achieved 0.8%; timber projected at plus 40% and fulfilled 1.7%.

Jasny's analysis shows that the wholesale price, expressed in 1926-26 rubles, was worth in fact only 70 U. S. cents in the case of farm products, 50 cents in the case of consumer's goods, 30 cents in the case of producers' goods, and some 25 cents in the case of industrial construction, and so on. In other words, the official statistics show a greater increase in value product than was true. The physical production multiplied by the true market value of the products fell far short of the statistically stated "value."

In analyzing the trade situation the writer states that with the moderate increase in total population, the near doubling of the urban population, and the compulsory bringing to market of products formerly made for family consumption only, by forcing bread, clothing, etc., through the retail trade outlets controlled by the government, causes an even larger percentage increase in cost to the consumer and a substantial decline in per capita purchases of consumers' goods measured in physical terms, by the rural and urban population.

In the chapter, "Allocation of National Income," the author makes an interesting analysis of military expenditures. He says that the total expenditures for the armed forces consist of those earmarked in the budget for this purpose and of those earmarked as the cost of constructing factories which produce armaments, barracks, and military airfields and which are included as "capital investments" in Soviet terminology. According to Jasny the large appropriation for the capital investments by the NKVD (department of interior), for extensive road construction, must have been of a military nature. The expenditures for military schools and academies and possibly all, or part, of the atomic bomb research are included among appropriations for education. The cheap production of tanks is compensated by raising greatly the prices of tractors. This would, of course, imply military expenditures to be under appropriations for agriculture. The

expenditures for military hospitals and sanitoriums were covered from general appropriations on these items. Pensions and compensations to veterans fall under social-cultural appropriations in the Soviet budget.

In the part of his work concerning consumption Jasny gives a careful analysis of living cost indexes and consumption in physical terms showing the greatly reduced supplies for the population of Rusisa of the most vital things. He underlines the significant fact with reference to consumption levels in cities—that housing space was reduced from the very small amount of 66 square feet per capita to 45 square feet per capita from 1928 to 1937 and continued decline later. Real wages now (1950), disregarding the substantial increase in number of hours worked, are considerably worse than in 1939.

Per capita consumption fell by about 40% during 1928-37 in urban areas, and by more than 50% in rural areas. The decline in the consumption of milk amounted to about 40% in cities and 30% in rural areas. As with food, the per capita consumption of cotton goods of the rural and urban population declined during the Plan era. The quantity of cotton goods available for private consumption fell from the low 15.2 meters per capita in 1927-28 to less than 10 meters per capita in 1940.

The vast propaganda machine of the Communist Party is paid for from the funds earmarked for education, just as is the expenditure on atomic research. It is one of the main causes for the increase from 1928 to 1937 in the education expenditure, which makes many admirers of Soviet system so proud.

In conclusion Jasny gives his opinion that the ability of USSR to expand its industrial output and "defense" preparedness rapidly, should in no case be minimized. According to Jasny, to do so is extremely dangerous. The expansion was attained by severe cuts in the consumption levels of the population.

In *The Soviet Price System* the author analyzes further the weakness in Soviet official statistics. He gives a study of "real" prices, inflation, deflation and rationing.

Soviet Prices of Producers' Goods concerns the prices which the Soviet industry charges the consumers. Jasny gives a careful study of price indexes for metals, fuel, machinery, construction and transportation.

These works of Naum Jasny on Soviet agriculture will help toward a better understanding of the real picture of the entire Soviet economy.

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Office Building Construction Manhattan 1901-1953. By Gordon D. MacDonald. New York: The Real Estate Board of New York, Inc. 1952. pp. 12. $25 (members, $10).

Fifty-two years of office building construction in Manhattan has made New York City the center of America's largest industry-business management. Of the 100 largest companies in the United States, more than 90 are represented in Manhattan, with headquarters or branch offices. Assessed valuations of the 1,172 office buildings in Manhattan total more than one and a half billion dollars; 365 of the outstanding office buildings in this group have assessed valuations of nearly one and a quarter billion dollars. These statements, included in the report by Gordon D. MacDonald, Director of Research for the Real Estate Board of New York, Inc. indicate the significance of the business management industry to New York City and incidentally to the members of the Real Estate Board of New York, as well as to non-members who are specialists on the various aspects of city life.

Real estate trends are well illustrated in a table giving the number of new office buildings constructed (1901-1953) by districts, which stretch from the downtown financial area in Manhattan to Columbus Circle at 59th Street. This table indicates the shifts in construction of office buildings, i.e., the movement in business from lower to central Manhattan, during the fifty-two year period. A second table compares construction of office buildings in the boom period (1925-33), with the post-war period (1947-53), also by districts, again indicating the northward trend in the new construction from lower to middle Manhattan.

The sources of funds for the financing of both competitive and non-competitive office buildings in Manhattan are presented in two different tables; outstanding is the relative significance of the role of the insurance companies.

A total of $80,000,000 in taxes in 330 buildings with unrented offices was paid to New York City during the period 1925-47. These data, presented graphically, show clearly the impact of the depression in the years between 1930 and 1936. Assessed valuations of competitive office buildings, completed or to be completed between the years 1947-53, are given in a series of tables in the appendix of the report; the assessments are presented in terms of the total number of buildings in specific districts and also in terms of selected buildings by street and number.

The above summary does not explain why this monograph of twelve pages is priced by the Real Estate Board of New York at ten dollars to Board members and at twenty-five dollars to non-members. Apparently from the Board's point of view, these twelve pages of concise factual data have dollar-and-cent-value to the real estate operator, sufficient to merit the price. Since an inquiry to the Board indicates that the monograph is in demand at the prices quoted, undoubtedly the surmise is correct. It is thus apparent that, although the monograph is of interest to the general public, it was not published primarily for this market but rather for the operator and investor in real estate, with a particular interest in the New York area.

ROASLIND TOUGH

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North Of The Circle. By Frank Illingworth. New York: Philosophical Library, 1952. 254 pages; pictures.

As far as is determinable the objective of *North of the Circle* is to prove to a lay reader that life in arctic areas may be comfortable rather than harsh. It is questionable whether the series of anecdotes given accomplishes the objective. Otherwise, the book is a more or less pleasant rambling which in total is incomplete, partly inaccurate, mostly undocumented, inadequately illustrated, and quite possibly overoptimistic.

Mistakes in fact are legion. Examples are: *up* the Yukon River toward the Bering Sea (p. 40); many place name spellings like Matuska (p. 73) for Matanuska and Revillajihedo (p. 154) for Revillagigedo; "no (agricultural) ground pests" (p. 68) re farming in spite of severe damage over the years from root maggots and cutworms in arctic vegetables; every statement but one about the Matanuska Valley Colony in Alaska (p. 73); "the Russians did not want to sell" Alaska (p. 152) in spite of historians' statements to the contrary; the Alaskan purchase "was the largest single deal in real estate in history" (p. 153) in spite of the 40% larger Louisiana Purchase just 64 years previously, the Malaspina Glacier "covers 1500 square miles" (p. 153) although showing to be 900-1000 on the most recent accurate maps; discussion of the periods of Alaskan development omits (p. 155) the beginning of fishing, Alaska's greatest industry; the Alaska Railroad succeeded the Alaska Northern rather than the Alaska Central (p. 157); paper money certainly was in use in Fairbanks prior to World War II rather than appeared then (p. 160); and A. E. Nordenskiold navigated the Siberian pack in 1878-79 rather than 1880 (p. 238).

Equally misleading is the looseness of writing throughout the book. For example: the author defines the Arctic as north of the "53rd Isotherm" (p. 4) without stating whether the line is for the year, winter, or month and without staying in this defined area for the rest of the book; inferring the ease of hearing wood chopped in —60° temperatures (generally considered almost too cold for this pursuit) to the low temperatures (p. 44) rather than the temperature gradient; use of the example of an 80-90-head herd of dairy cattle in Fairbanks (p. 72) where there are perhaps three such in the whole area; an item on tides of "as much as forty feet" (p. 81) without the addition that tides of five feet in most of the Arctic Ocean are uncommonly high; a declaration that the Bering Straits are strategically analogous to the English Channel (p. 247) which is subject to serious question; and the statement that "there could be no doubt" that Russia would move into eastern Alaska in case of hostilities (p. 247) which omits consideration of the bigger task of holding an area after it has been captured.

Other disappointing statements are those too optimistic. There is doubt that: the thousands of soldiers who were in the Artic during the last war returned with stories of "conditions suitable to a population of millions" (p. 21); there are "many examples" of large-scale agriculture in the Arctic (p. 70);

the Hudsons Bay Company observed Arctic weather "long before the Government thought to enter this field" (p. 220); or that Alaska and eastern Siberia are what "the Americans call the most strategical areas on earth" (p. 245).

Finally, the omissions in the text are a cause of concern. The absence of any map is unexplainable. On page 158 the description of Alaskan towns omits Anchorage, Alaska's biggest center. The gold strike at Fishwheel, Alaska (p. 158) was "salted," details are given excepting this. Chapter X, The Russian North, covers 10 pages as opposed to Spitzbergen's 27 pages and without mention of the Northern Sea Route Administration in charge of Siberian development north of 62° latitude nor of population distribution or changes (as reported in Webster's excellent *Arctic* May 1951 article). Developments at the Quebec-Laborador iron reserve are unreported as well as the decline of the Icelandic herring fisheries with the northward shifting of ocean currents (p. 239).

To be sure, one probably should not expect, as much as he may wish, a book on the Arctic for the lay public to be complete, scientifically accurate, and easily understandable. However, it is fair to look forward to an organized approach which aims for completeness of coverage with the same degree of detail and includes data in easily accessible documents, photographs, maps, and statistics.

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World Population and Future Resources. Edited by Paul K. Hatt. New York: American Book Company, 1952. pp. xviii, 262.

This book gives a well-rounded picture by 20 specialists in four major areas. Part 1 treats the population factor, Part 2 food resources, Part 3 material resources of industry, and Part 4 energy resources. Part 1 discusses such things as the future growth of world population, the future of transitional areas and needs of world population. Part 2 goes into land and water resources, the possibility of increasing food production, and world food needs. Part 3 discusses mineral resources, structural materials, and the possibility of new products. Part 4 treats the future of our basic energy sources: coal, liquid fuels, atomic energy, and the possibility of solar energy.

The book is a symposium and is one of the better source books that has appeared in recent years on the relationship of population to resources in specific areas. It suffers from the usual pains of 20 authors, although the editor has done a fine job of integrating the material. Much could have been added if a concluding chapter consolidating the highlights had been included. However, this is a minor criticism since the assets of the book far outweigh any of the minor failures.

It is interesting to note that the social scientists tend to be much more pessimistic about the possibility of applying food and shelter to our growing population than do the physical scientists. The social scientists tend to feel that population controls, whether voluntarily applied through the limitation of family size or through some negative factor such as a rising death rate, will be necessary in the near future. The food scientists are reasonably optimistic that food can keep ahead of people if given the necessary funds for basic research. It is important to note that many of the scientists writing in Parts 2, 3, and 4 feel that more money must be spent on fundamental research in order to solve the food, fiber, and material problem.

The authors writig abount energy feel that coal and liquid fuels are still the basic source of energy, although there might be possibilities from atomic and solar energy. They remind us that new sources must be found and more efficient ways of recovering energy must be used.

The book is a sobering commentary on the inability of man to control his own destiny and to keep his growth within reasonable bounds. Social scientists writing in the first five chapters remind man he must do more thinking and planning if he is to live at least at a reasonable level of living. The physical scientists give us much hope, but this hope is obviously based on vast sums being spent on basic research and a free flow of knowledge.

The book is a valuable source of information for not only social scientists but obviously for those who are concerned with the relation of food, resources, and population. It will be a valuable text in both sociology and economics.

Although it is impossible to treat all the contributions made by the 20 specialists, a

few highlights might encourage the reader to explore the book. Irene Taeuber reminds us that "transfer from the past experience of Japan to the future experience of agrarian Asia is difficult, though, for the peculiar combination of circumstances that permitted and produced the Japanese transition is unlikely to be duplicated in the still underdeveloped areas." Frank Notestein suggests that "certainly the world's poverty is not due to its small population. Rather it is due to an inappropriate distribution of people in relation to resources, and to the inadequacies of mankind's social, economic, and political arrangements." J. Russell Whitaker points out that the land in use must be made to produce more food and fiber. J. J. Christensen reminds us that greatly increased yields of crops have been achieved by using improved varieties, modern farm practices, improved fertilizer, and adequate moisture. Finally, Walter J. Murphy says, "The problem, in my opinion, is not 'overpopulation' but 'underuse' of the scientific knowledge we already possess."

DOUGLAS G. MARSHALL

University of Wisconsin

Unpublished Studies on Public Land Policies and Problems*

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   Thesis (Ph.D.). Department of History and Govermnent, Harvard University, 1890.
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   American Policy for Natural Resources: An Historical Survey to 1862. Cambridge, Mass., 1950.
   Thesis (Ph.D.). Department of Political Science, Harvard University, 1950.
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   Thesis (M.S.). University of Wyoming, 1948.
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   The Acquisition and Disposition of the Public Domain. Corvallis, Oreg. (n.d.) Manuscript in School of Forestry, Oregon State College.
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   Unpublished Study in files of Economics Department, Michigan State College.
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14. Moore, Allie S.
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* This list was compiled by Robert W. Harrison, Agricultural Economist in the Bureau of Land Management, United States Department of the Interior, in consultation with its Director, Marion Clawson.

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A History of Public Land Policies in Florida, 1819-1900. Durham, N. C., 1940.
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History of Bingham County, Idaho. Laramie, Wyo., 1942.
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